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ABSTRACT

This report describes an auding and reading model that accounts for the development of receptive oracy and literacy skills. The model presents a classification scheme for the development of reading and auding skills which considers basic adaptive processes, languaging precursors, and languaging processes. Four hypotheses consistent with the model were derived: (1) the ability to comprehend language by auding will surpass ability to comprehend language by reading during early school years, until reading skill is acquired, after which the ability to comprehend by auding and reading will become equal; (2) performance on measures of ability to comprehend language by auding will be predictive of performance on measures of ability to comprehend language by reading, after reading skill is acquired; (3) performance on measures of reading rate and auding rate will be comparable, after reading decoding skill has been developed; and (4) training in comprehending by auding will transfer to reading, after reading skill is acquired. Research findings reveal that reading is based on, and utilizes, the same conceptual base and languaging competencies as auding, and that reading skill can be improved through training in languaging using oracy skills (auding and speaking). (Author/SW)

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AUDING AND READING:
A DEVELOPMENTAL MODEL

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This report describes an auding/reading model that accounts for the development of receptive oracy and literacy skills. The model presents a classification scheme for the development of reading and auding skills which considers basic adaptive processes, languaging precursors, and languaging processes. Four hypotheses consistent with the model were derived: (1) the ability to comprehend language by auding will surpass ability to comprehend language by reading during early school years, until reading skill is acquired–following which time the ability to comprehend by auding and reading will become equal; (2) performance on measures of ability to comprehend language by auding will be predictive of performance on measures of ability to comprehend language by reading,

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after reading skill is acquired; (3) performance on measures of reading rate and auding rate will be comparable, after reading decoding skill has been developed: and (4) training in comprehending by auding will transfer to reading, after reading skill is acquired. An extensive literature review of empirical data bearing on the model supported each of the four hypotheses. It was concluded that reading is based upon, and utilizes the same conceptual base and languaging competencies as used in auding, and that reading skills can be improved through training in languaging using oracy skills (auding and speaking). Other conclusions and implications of the model are provided, including suggestions for improving literacy training and directions for future research.

SUMMARY

Problem

Many personnel who enter the Air Force and other Armed Services lack sufficient literacy skills for technical training and successful career progression. Because of the crucial role that literacy plays in instruction and job performance, information regarding the nature of literacy skills and their development is needed. Such information should prove useful in the development of literacy training programs, and in the development of more effective and/or efficient methods for imparting knowledge by the spoken or printed word.

Approach

Because several recent reviews of the scientific literature on reading and language skills failed to uncover many salient facts for use in guiding literacy research or development of literacy training programs, it was felt that the present review should be guided by a theory or model which could provide a rationale for sorting, sifting, and interpreting various research studies. Accordingly, a simple model of the development of oracy and literacy skills was developed, and literature was reviewed and synthesized within the framework of the model.

Results

The model proposes four major sets of processes in a developmental sequence to describe the development of auding and reading: (a) the basic adaptive processes (BAPs—seeing, hearing, cognitive, motor movement), (b) the languaging precursors (listening and looking), (c) the oracy languaging processes (auding and speaking), and (d) the literacy languaging processes (reading and writing). The BAPs of seeing and hearing are considered as mechanical or automatic operations that occur as simple physiological responses to structural environmental information; no active, mediating cognitive processing is involved in extracting and registering this information. Listening and looking, conversely, are information-processing activities that involve an active or intentional selection, manipulation, and utilization of information. Auding and reading are specialized listening and looking activities; they entail the extraction and conceptualization of information from a system of conventionalized signs. Within the model's structure, languaging and conceptualizing are major competencies which undergird the auding and reading processes.

Consistent with the model's treatment of language as a central, or common, component in the cognitive content of an individual despite the mode of information reception (i.e., auding or reading), four hypotheses were derived. These are:

(1) Performance on measures of ability to comprehend language by auding will surpass performance on measures of ability to comprehend language by reading during the early years of schooling, until reading skill is learned, following which time the ability to comprehend by auding and reading will become equal.

(2) Performance on measures of ability to comprehend language by auding will be predictive of performance on measures of ability to comprehend language by reading, after reading decoding skill is acquired.

(3) Performance on measures of rate of reading and rate of auding will show comparable maximal rates of languaging and conceptualizing, after reading decoding has been developed.

(4) Training in comprehending by auding will transfer to comprehending by reading, once the reading skill has been acquired.

A review of relevant experimental data provided support for each of the four hypotheses. Confirmation of the hypotheses furnishes evidence for the developmental model of reading—that reading is based upon, and utilizes, the same conceptualizing and languaging competencies that are used in auding (plus the additional competencies necessary to convert the visual display into an internal auditory display).

Implications

(1) Reading ability is built upon a foundation of language abilities both developed and expressed largely by means of the oracy skills of auding and speaking. For this reason, a much greater emphasis than has previously been shown should be given to the development of:

(a) Methods for characterizing and assessing oral language as a developing ability, and in relation to reading skills development. For instance, an auding-reading test battery would be useful in indexing discrepancies between these skills, and in revealing the extent to which reading problems reflect difficulties in decoding, languaging, or conceptualizing.

(b) Methods for improving oral language skills as foundation skills for reading. An oracy-to-literacy sequence of training would seem desirable in teaching new vocabulary and concepts to unskilled readers; it would reduce the learning burden by not requiring the simultaneous learning of both vocabulary and decoding.

(2) Both oracy and literacy language skills rely upon conceptualizations formed from knowledge and stored in memory. It is necessary, therefore, that an auder or reader have an adequate, relevant knowledge base for comprehension of printed or spoken messages to occur. This suggests that:

(a) There is a need for research to determine how "old" knowledge is used to acquire "new" knowledge by oracy and literacy skills, and to develop methods by which a person can examine what he already knows and manipulate this knowledge to either create new knowledge or obtain new knowledge.

(b) There is a need for research and development to ensure that students acquire the requisite knowledge base needed to perform significant adult literacy tasks. For instance, knowledge specific to a particular occupational cluster might be taught, in addition to school-related academic literacy.

(3) Because high skill levels in reading presuppose high skill levels in decoding and oral language, and a broadly developed conceptual base, government agencies sponsoring remedial literacy programs ought to be prepared to offer support for programs of longer

duration than they currently do. The development of oral language skills and broad bases of knowledge requires considerable practice, drill, study, and time for assimilation and accommodation processes to build adequate cognitive structures.

(4) Because the Air Force is concerned with literacy training which will improve a person's capacity to accomplish his job and advance in his career, *job-related literacy training* should be emphasized in the remedial literacy program. This will build the most immediately relevant knowledge base. However, because learning the meanings of job-related terminology and concepts, and the development of automaticity in decoding job printed materials will require considerable time, the Air Force should consider a program of literacy training of sufficient duration, and with suitable job-related content, to promote fully developed job literacy skills. *Computer-assisted instruction* would seem to lend itself to this type of job-related training because:

(a) The need to keep job-reading materials up-dated suggests the use of computer editing and revision of text capabilities to maintain currency of materials.

(b) The need to carefully assess students' knowledge in relation to the to-be-learned knowledge suggests the use of adaptive testing programs and assessment procedures. The computer might then be used to generate *personalized* materials to facilitate transfer of old knowledge to the learning of new knowledge.

(c) The need for drill and practice suggests the use of computers with programs for using *accuracy and response latency* data to determine when sufficient skill has developed.

PREFACE

This research report was prepared by the Human Resources Research Organization (HumRRO), Alexandria, Virginia, under Air Force Contract F41609-73-C-0025. Dr. James R. Burkett, Air Force Human Resources Laboratory Technical Training Division, Lowry Air Force Base, Colorado, served as Contract Technical Monitor.

The research was conducted by HumRRO Western Division, Presidio of Monterey, California, where Dr. Howard H. McFann is Director. Principal Investigator for the research was Dr. Thomas G. Sticht.

Special consultants to the project were Mr. Glenn Kleiman, Stanford University, who had major responsibility for the preparation of Chapter III of the report, and Mr. James H. James, Northern Illinois University, who contributed primarily to Chapter V. Both consultants reviewed and commented on the entire report and hence they appear as authors.

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Chapter I

INTRODUCTION

LANGUAGE AND LEARNING

Although an almost bewildering number of sophisticated instructional aids—from computers to tutors—exist today, perhaps the oldest, most ubiquitous, and least understood is *language*.

The use of language for instructing begins at an early age, in the child's home, and its use multiplies and compounds during schooling until, at the University, students are engulfed in a four-year "swarm" of oral and written language units—which Rothkopf has estimated may approach 6 million to 12 million words! (1972, p. 316)

Students in Universities are not the only ones who encounter formidable linguistic "swarms" in their education. In 1965, some 2,935,000 students were enrolled in correspondence courses; 1,767,400 of them were Armed Forces personnel (MacKenzie, Christensen, and Rigby, 1968, p. 7). For these students, the written language is the primary instructional tool. No one knows how many *oral* language units the Armed Forces and other organizations use in their instructional programs, but the lecture method, along with many reading assignments, still dominates the scene.

Even in innovative instructional systems, such as the Air Force's computer-based Advanced Instructional System (AIS) concept, a great deal of instruction consists of oral and written language. Most computer displays—like most educational films, film strips, or illustrations—are unable to present concepts, especially abstract concepts, without oral or written language.

Many non-hardware based instructional innovations, such as peer instruction, role playing, and T-groups, also seem to rely heavily on language for their effectiveness although, in such practices, the relative contributions of linguistic and non-linguistic affective factors to the achievement of the educational objectives are unknown.

It seems clear that, because of the central role language plays in instruction and learning, there is a need for as complete and sound an understanding as possible of (a) how people learn their various language competencies and (b) how they gain knowledge by use of these competencies (*cf*., Carroll, 1968).

The first problem, how people learn various language competencies, is of special concern to the Air Force and other armed services because many recruits are poorly developed in a major language competency—reading. For personnel reading below the sixth grade level, the Air Force conducts a reading training school at Lackland Air Force Base, Texas, which a given airman may attend for eight weeks or longer (OASD/M&RA Report on Project One Hundred Thousand, 1969). During the period October 1967 September 1969, some 3,288 men entered the Air Force literacy program. As of

December 1969, the entry rate was about 250 per month, mostly Project 100,000 personnel (recruits with Armed Forces Qualification Test scores from 10 to 20). While current entry rates are much lower than the 1969 figure, the program is still a costly one.

Furthermore, it seems probable that the reading problem faced by the Air Force is actually greater than indicated by the above figures, because the reading demands of jobs are likely to be higher than sixth grade reading ability. Research on the literacy requirements of Army jobs suggests that jobs such as auto repairman or supply clerk may actually require eighth or ninth grade reading ability—at a minimum (Sticht, *et al.*, 1972). It seems unlikely that Air Force jobs have lower reading requirements than these Army jobs.

Thus, we can reasonably speculate that the Air Force faces a considerable reading problem. For this reason, information about the reading process and how it is acquired is sorely needed, to facilitate the development of innovative methods for effectively and efficiently improving the reading skills of Air Force personnel up to and beyond *minimal* requirements.

Closely related to the problem of improving reading competencies of personnel is the second problem mentioned earlier, that of improving the effectiveness of reading and other language competencies for acquiring new knowledge. Research in this area may deal with methods for teaching better study skills (e.g., note taking, time management), but it is perhaps best typified by attempts to develop better methods for displaying language materials in spoken or written form to increase or facilitate learning. This type of activity makes up much of the R&D in audiovisual media, programmed texts, attempts to improve the readability of printed texts, and a host of studies on verbal learning. For the most part, these activities assume the reading and other language competencies needed to learn from the printed or spoken displays, and are not concerned with how to teach reading or auding (listening to spoken language) as basic skills.

Because of the interdependencies between processes involved with the two types of problems—learning *of* language competency and learning *by* language competency—a proper understanding of the latter would seem to presuppose a proper understanding of the former. For this reason, the present report focuses upon the problem of the acquisition of language competency in general, and specifically upon the problem of the acquisition and development of the receptive language skills of auding and reading.

PREVIOUS REVIEWS ON THESE TOPICS

Just recently there have been several major reviews of "basic" research on the nature of the reading process (Davis, 1971), relation of speech to reading (Kavanagh and Mattingly, 1972), the measurement and teaching of auding and reading skills (Duker, 1968; Carroll, 1968, 1972; Corder, 1971), and learning from audio or printed displays of meaningful verbal discourse (Carroll, 1971). Unfortunately, these many reviews reveal little of practical value for improving auding or reading skills.

This is not a singular conclusion. Regarding research on methods for teaching reading, the results of the most recent, most extensive literature review were succinctly stated: "It is clear that the present body of literature is too incomplete, too fragmented, and too often conducted and reported in too general a level to be very useful" (Maxwell and Temp, 1971, p. 137). Linguistic theories of language acquisition have been reviewed by

Wardhaugh (1971) with the general conclusion: "The theories of language acquisition that are available to us today are largely irrelevant in deciding issues in beginning reading instruction or even in devising models of the reading process" (pp. 6-179). Also concerning language acquisition models, Athey (1971) concludes: ". . . the models have little or nothing to say about reading" (pp. 6-65). In the preface to a leading "renaissance" volume in basic research on reading, Levin and Williams (1970) state: "We have nothing to add to the fantastically large, and for the most part ineffective, literature on teaching people to read. . . . these studies are not concerned with practical issues of reading instruction" (p. ix).

Even in such fundamental areas as the measurement of listening (auding) and reading ability, a problem long assailed by psychometric specialists, we find Carroll (1972) lamenting that " 'Listening comprehension' and 'reading comprehension' are two phrases that appear frequently in educational literature, but there is much study and debate as to what those phrases might mean" (p. 2). He refers to the STEP Tests of Listening published by ETS (Educational Testing Service, 1956-59) as a "true hodge-podge" and is disturbed that ". . . the various tests of 'listening ability' tend to show no higher intercorrelations among themselves than they show with reading and intelligence tests" (p. 2).

When we turn to research on the development of effective procedures for using the language competencies in acquiring new knowledge, we again encounter a formidable literature—although not many useful results for instructional purposes. Rothkopf (1972) has questioned the value of studies from verbal learning laboratories to learning by reading in realistic settings. In turn, Carver (1972) has critically reviewed Rothkopf's and other research on "mathemagenics" and concluded that "The tasks used in the experiments were not valid when generalizing to any applied situation and were not valid for generalizing to any situation of theoretical interest" (p. 116). Carroll (1971) thinks that the concept of mathemagenics is useful, yet he agrees that "Carver's criticisms have some force; many of the points he raises should be made the basis for further experimental investigations" (p. 166).

Various attempts to improve learning from listening materials have been reviewed elsewhere (Sticht, 1972) with the general conclusion that such efforts have, to date, been largely ineffective.

The question of the relative effectiveness of spoken versus written discourse, or a combination of the two (audio-visual media), on learning outcomes has most recently been considered by Carroll (1971). His comments on past reviews in this area suffice to bring the reader up to date: "All these reviews suggest that the matter is an extremely complicated one; research seems to present conflicting evidence on numerous points" (p. 129).

A CALL FOR THEORY

As the number of empirical studies grows larger and larger, with seemingly little progress being recognized on how people learn to read and how they read to learn, we find more and more often the call for theory-based research. Anderson (1972), Bormuth (1970), Carroll (1972), and Simons (1971) have called for theories of language comprehension. Geyer (1971) reports more than 40 models or partial models of the reading process or its components. Bloom (1971), commenting on operant conditioning and cognitive psychology approaches to reading (behavior?), feels that we are witnessing a paradigm clash *a la* Kuhn (1962) between behaviorist and cognitive psychologists, from which the better paradigm will eventually emerge dominant. Frase (1969), speaking about the discipline of instructional psychology in general, and the problem of learning from meaningful verbal discourse in specific, has succinctly summarized what many have felt is a major problem: Our empirical data are not adequately organized, hence they do not provide knowledge—just facts—and many of these facts are tenuous at best.

AND YET ANOTHER LITERATURE REVIEW

While the conclusions of the major literature reviews already cited would seem to discourage yet another literature review on relationships of auding to reading, we believe that such a review may be profitable—if we follow Frase's injunction and organize the existing facts according to some systematic scheme.

One such scheme was developed by Schlesinger (1968) and modified and used by Carroll (1971) in his extensive review on learning from verbal discourse:

> "A description of what this review intends to cover can therefore be stated as:
>
> the $\begin{Bmatrix}\text{ease}\\ \text{readiness}\end{Bmatrix}$ with which linguistic material in $\begin{Bmatrix}\text{spoken}\\ \text{written}\end{Bmatrix}$ form with
>
> (given) $\begin{Bmatrix}\text{cognitive}\\ \text{emotional}\end{Bmatrix}$ characteristics or $\begin{Bmatrix}\text{content}\\ \text{style}\end{Bmatrix}$, presented in a
>
> (given) manner, $\begin{Bmatrix}\text{with}\\ \text{without}\end{Bmatrix}$ supporting context, is decoded (understood,
>
> learned, remembered) by members of a (given) population" (pp. 2-3)

While such a system is useful for categorizing studies into the bracketed categories (which is all Carroll intended it for), it provides no basis for theoretical integration, for the construction of relationships among the "facets" of the statement. Moreover, it generates no useful hypotheses for extending beyond the assembled facts. For these reasons such a scheme is not a very useful tool for literature review and synthesis beyond the fact-sifting stage.

In an attempt to overcome some of the shortcomings of outlines or other simple categorization schemes for sorting empirical findings from a literature review, we adopted a plan of surveying literature bearing on a model constructed to have a broad degree of generality—a model of the gross processes and sequences involved in the development of auding and reading competencies. Our use of the term "model" is essentially the same as that of Gephart's, quoted by Geyer (1971). That is, a model is ". . . a representation of a phenomenon which displays the identifiable structural elements of that phenomenon, the relationship among those elements, and the processes involved in the natural phenomenon." Furthermore, a model should serve three general purposes: ". . . to explain what a complex phenomenon consists of; to describe how such a phenomenon works; and to provide the basis for predictions about changes which will occur in one element of the phenomenon when changes are made in another element."

The phenomenon represented by the model we are constructing is a developmental sequence—the sequence that ordinary, literate persons go through in becoming literate. While the developmental model as presently constructed is molar in perspective and does not meet all of Gephart's requirements, it nonetheless generates some testable hypotheses and hence is capable of a measure of self-correction.

Our goal is to build a model that can serve as an ideational scaffolding of sufficient generality that more specific models—such as models of "the reading process" (Mackworth, 1972) or speech encoding and decoding (Cooper, 1972)—can be attached where they appear to serve the most useful explanatory function. In this manner, a more complete understanding of the processes involved in the development of reading competency may be achieved. We have, then, the expectation that growth in our knowledge of this sequence and the processes involved will bear fruitful insights for facilitating the acquisition of reading skills by children or adults who desire to learn these skills, and for developing improved procedures for instructing by printed or spoken discourse.

OVERVIEW OF THE REPORT

In the remainder of this report, attention is first focused in Chapter II on describing the developmental model, including the definitions of basic terminology, and the description of relationships among the major processes included in the model. Chapter III elaborates upon the processes of "conceptualizing" and "languaging" introduced in Chapter II, and presents a brief account of selected aspects of the acquisition of these processes.

In Chapter IV, discussion centers upon the development of listening and looking as processes for scanning information in acoustic or optic displays so that selected information relevant to a person's current cognitive demands might be extracted. The emergence of auding as a special type of listening, and reading as a special type of looking are discussed, and similarities and differences between auding and reading are described.

In Chapter V, emphasis shifts from the explication of concepts in the model, to the survey of literature bearing on four hypotheses deduced from the model. Finally, Chapter VI presents a summary and discussion of the findings of the literature survey, and presents recommendations for future research and/or development efforts to improve the teaching of auding and reading, and for improving learning from spoken or written language displays.

Chapter II

THE DEVELOPMENTAL MODEL OF AUDING AND READING

Typically, children are born with capacities for adapting to the world around them. Through these capacities children acquire language. Then they may, if in a literate society, learn to read. This is the developmental sequence with which we are concerned.

Figure 1 presents an overview of the model; it includes all the basic elements and attempts to give some impression of their interrelations within a developmental sequence. Table 1 defines each of the major terms used in the model.

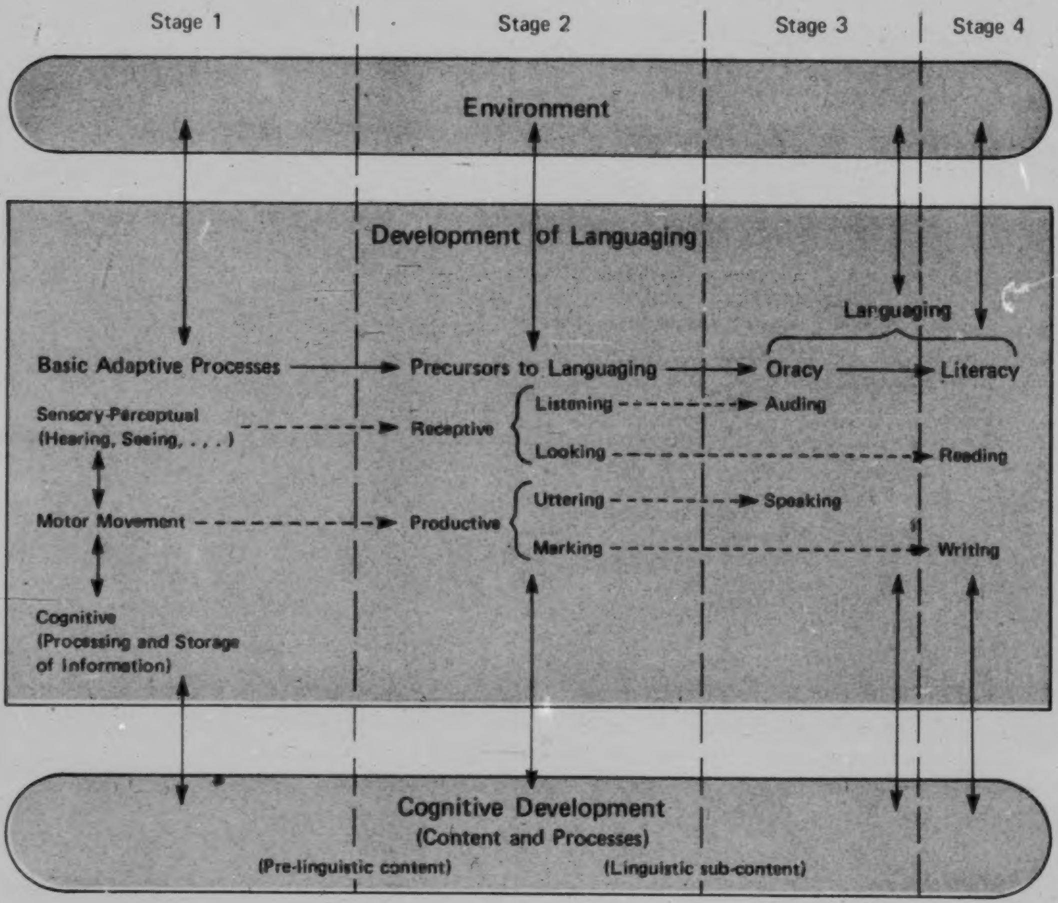
Stage 1
Stage 2
Stage 3
Stage 4
Environment
Development of Languaging
Languaging
Basic Adaptive Processes
Precursors to Languaging
Oracy
Literacy
Sensory-Perceptual (Hearing, Seeing, . . .)
Receptive
Listening
Auding
Looking
Reading
Motor Movement
Productive
Uttering
Speaking
Marking
Writing
Cognitive (Processing and Storage of Information)
Cognitive Development
(Content and Processes)
(Pre-linguistic content)
(Linguistic sub-content)

Fig. 1. **Overview of the model of the development of languaging.**

Table 1

Definitions Used in the Model

1. Basic Adaptive Processes (BAPs): Sensory, Perceptual, Motor, and Cognitive capacities operating at birth by means of which the infant adapts to the environment.
   - 1.1 Hearing: BAP for reception of sound.
   - 1.2 Seeing: BAP for reception of light.
   - 1.3 Motor Movement: BAP for orienting to and manipulating the environment.
   - 1.4 Cognitive: BAP for storing, retrieving, and using information.
2. Precursors to the receptive processes for languaging.
   - 2.1 Listening: Selecting and attending to excitation in the auditory modality.
   - 2.2 Looking: Selecting and attending to excitation in the visual modality.
3. Precursors to the expressive processes for languaging.
   - 3.1 Uttering: Production of vocal sounds; i.e., sounds produced using the larynx and oral cavities.
   - 3.2 Marking: Manual motor movements producing marks (lines, scribbles) on environmental surfaces.
4. Language (noun): System of a) conventionalized signs, and b) rules for selecting and sequencing these signs.
   - 4.1 Language (verb—to language, languaging): Representation of conceptualizations by properly ordered sequences of signs; or the inverse process of understanding the conceptualizations underlying the sequences of signs produced by others.
5. Oracy Processes
   - 5.1 Auding: Listening to speech in order to language.
   - 5.2 Speaking: Uttering in order to language.
6. Literacy Processes
   - 6.1 Reading: Looking at script in order to language.
   - 6.2 Writing: Marking in order to language.

The model asserts that infants first come into this world with certain basic adaptive processes (BAPs) which permit them to adapt, with greater or lesser effectiveness and efficiency, to their environment (See Stage 1 of Figure 1). Examples of these basic processes are: hearing and seeing, which are BAPs for the reception of sound and light; motor movement, which is the BAP for orienting to and manipulating the environment; and the cognitive BAPs, which include the basis for a memory system and rudimentary ways of processing (i.e., storing, retrieving, and using) information.

The basic adaptive processes interact with the infant's environment; this interaction leads to the infant's attainment of advanced capabilities of sensori-motor control expressed in the "precursors to languaging"—listening and looking (information reception) and uttering and marking (information production) (Stage 2 of Figure 1). The distinctions between hearing and listening, and between seeing and looking, are fundamental to the model. The present analysis emphasizes that the parallel BAPs of hearing and seeing are separated from listening and looking on a functional basis. Hearing and seeing are considered to function as mechanical or automatic outcomes of the operations of the auditory or visual anatomical structures, while listening and looking are considered to be information-processing activities that depend upon and nurture sensory-perceptual-cognitive-motor development and integration, and that are used by the person in actively selecting information from the environment.

This conception of looking and listening activities is not unlike that of Hochberg (1970a). He considers these activities as information-processing activities involving an "intention," that is, purpose on the part of the person. The Gibsons (J. Gibson, 1966; E. Gibson, 1969) too regard listening and looking as active information-processing activities which the person uses to seek out stimulation for constructing internal representations of the environment.

It should be noted that although the information resulting from binaural hearing may be used by the neonate to bring about reflexive visumotor orientations to acoustic stimuli (Wertheimer, 1961), and hence, form a rudimentary type of "looking" and "listening" (J. Gibson discusses this type of "listening," 1966, p. 83), we exclude such reflexive activities from our definitions of these processes.

An essential characteristic, then, of listening and looking is that they are active processes under the control of the individual. These activities are used by the individual to pick up information from the environment relevant to current, conscious, mental construings. In this regard, following Atkinson and Shiffrin (1971), it is conjectured that, in fact, it is the active process of seeking information and manipulating it in short-term memory that is our experience of consciousness or self-being in the world.

It is a mystery, of course, how the individual comes to have self-awareness or the experience of being a separate, conscious being. The suggestion, however, is that this occurs as the individual comes to have control over what he will hear and what he will see through the integration of BAP systems to produce listening and looking activities. Hence, developmentally, although hearing and seeing precede listening and looking, we believe the former processes operate at the stage prior to conscious information seeking and manipulating, and act as automatic organizers of the environmental stimulus-energy flux. Only with sensory-psychomotor coordination and experience stored in memory can the control processes take place in short-term memory, which make possible the information-processing activities of listening and looking.

Both listening and looking can also be construed as activities subservient to the more general process of "paying attention" to something. We can define "paying attention" to mean the constructing of, and performing of mental operations on, internal representations in active, short-term memory. The representation may be a recollection from long-term memory (i.e., an idea, a fantasy, an image, an internal speech, etc.) and we may be attending to it in a dream, a daydream, or in deep, reflective thought. The representation may also be an amalgamation of information from long-term memory with information being accessed from outside the person. In this case, the person may use listening, looking, and manipulating to obtain external information for merging with information from long-term memory to construct the internal representation, whether this is a visual image or a thematic context involving both verbal and visual components.

Also affected by the interaction of the BAP with the environment, as well as the more advanced processes of looking and listening, is the child's knowledge or "cognitive content" and his ways of processing information. In Figure 1 these are grouped together and simply called "cognitive development." In turn, the child's cognitive content influences his listening and looking processes by affecting what is selected and attended to, as well as how the information obtained by looking and listening is integrated with previous knowledge.

The view being used here is that the newborn infant's sensory-perceptual systems are primarily *re*active, with reflexive actions but no active, goal-oriented cognitive directing. However, the infant is viewed as acquiring some form of the active, self-directed processes of looking and listening, as well as their prerequisite cognitive content, very rapidly. This prerequisite cognitive content includes what we call the ability to "conceptualize," to combine non-linguistic elements by using one or more relations—in other words, to form a proposition, a thought, an idea, an image, or, in the generic term we use for all these, a "conceptualization." The "conceptual base" consists of the basic elements and relational rules used to conceptualize. Possible ways of considering this cognitive content include Piaget's (*cf.*, Flavell, 1963) ideomotor schemata and Schank's (1972) conceptual base. These will be discussed further in Chapter III.

The cognitive content includes the conceptual base plus specific individual conceptualizations that are stored in memory: that is, knowledge. Into this content the child begins to assimilate, in part through the foregoing processes, certain *conventionalized signs*—people-produced communication displays which stand for some internal meaning—and rules for selecting and sequencing these signs. That is, the child's cognitive content will come to contain a sub-content called language.

In our way of thinking, this language sub-content will consist of whatever signs, and rules for sequencing these signs, that the child is exposed to for any significant amount of time. Thus, the signing language of the deaf may come to constitute a major portion of the language content of a deaf person. Even in hearing persons, however, we expect certain nonverbal, gestural symbols to constitute a subset of the language signs and rules. Thus, we do not restrict the concept of language to the spoken language—although it is the spoken language that is of major interest to us.

Typically, at about the age of two years, the processes of listening and uttering begin to be used for languaging; the child has begun to use the oracy processes of auding and speaking (Stage 3 of Figure 1). When a child's listening is directed toward speech, rudiments of verbal language comprehension begin, and a specialized listening activity—*auding*, the process of listening to speech in order to language—is defined. Auding is a subset of the more general class of activities involved in listening. This means that while there are listening-but-not-auding activities, there are no auding-but-not-listening activities. Auding is a special kind of listening. When the child begins to produce utterances that resemble the speech he listens to, we say he is *speaking*. Thus speaking is derived from and forms a subset of the more general activity of uttering.

Both auding and speaking are special cases of the more general process of "languaging," which is the process of communicating ideas by using properly ordered sequences of signs for the representation of mental conceptualizations (which are derived from the cognitive content and processes), or the inverse process of understanding the conceptualizations underlying the sequences of signs produced by others in communicating.

One significance of the foregoing analysis is that it makes clear the need, when assessing *auding* ability, of distinguishing factors that affect listening and hence auding test performance, from languaging factors that affect auding test performance. For auding and speaking, plus the signs and rules used for graphic display of language elements (e.g., spelling patterns; representation of homophones such as site, cite, and sight).

By the present model, reading is construed as a special kind of looking—looking at print in order to language. For beginning readers, the model subscribes to the two-stage hypothesis from linguistics (Carroll, 1970; Fries, 1962) which asserts that the early reader looks at print to convert it to the spoken representation of meaning, and then comprehends the spoken symbols. For advanced readers, the model assumes that the reader may look at print and convert it directly into language content (words, phrases, or sentences) without necessarily involving the spoken representation of the language content, although such conversion is possible and may even be typical for the advanced reader (see Hypothesis 3, Chapter V).

At this point, we are not going to review literature for or against the different stage hypotheses. The major points we wish to make here are that, according to the present model, (a) reading occurs after oracy competency is fairly well developed, and utilizes the same language content (signs, rules) as used in the oracy skills, plus the special competencies needed for understanding language in written form; and (b) reading is a special case of the more general information-processing activity of looking, hence there are looking-but-not-reading activities, but no reading-but-not-looking activities.

Thus, as with auding, reading ability is influenced by at least two sets of factors: (a) the competencies needed for visually exploring and extracting information from visual displays, such as the use of peripherally encountered information to efficiently guide foveal scanning (Schiffman, 1972); and (b) languaging factors, including the scope of the sign system and the effectiveness with which this system is used for inter- and intrapersonal communication.

Figure 2 presents a schemata of the various processes discussed earlier, as well as some to be discussed later on. Here we will mention only receptive languaging processes, but a similar account holds for the expressive processes. Auding is the joint occurrence of

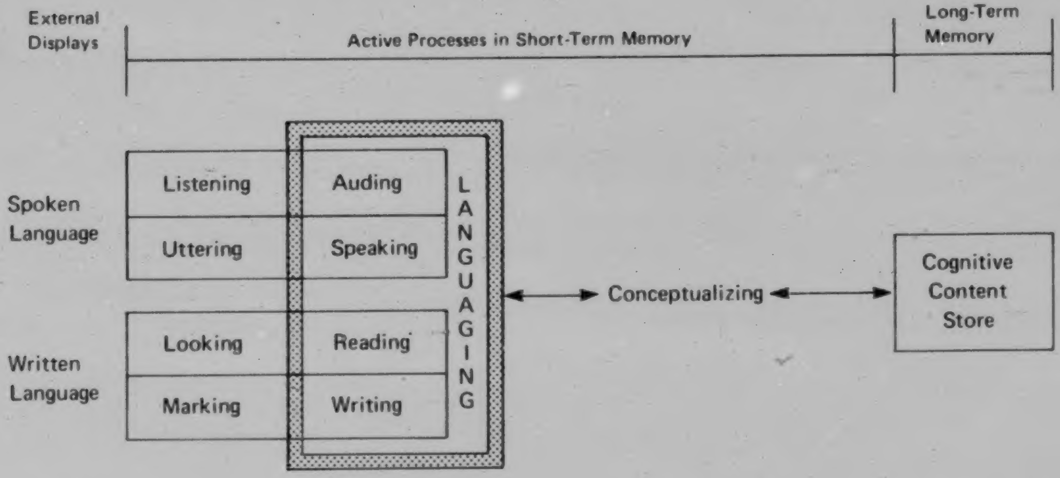

Fig. 2. **Processes in languaging.**

languaging and listening processes; reading is the joint occurrence of looking and languaging. The receptive languaging components serve to transform verbal or printed displays into non-language conceptualizations which constitute the meaning of the message to the receiver. The conceptualizing process continually merges input from the languaging process with information from the cognitive content store to build the subjectively experienced, meaningful message.

All of the active processes of listening/looking, auding/reading, languaging, and conceptualizing take place within a time span constituting short-term memory. Through these activities, and other control processes, information can be added to the information stored in long-term memory, which forms the cognitive content or conceptual base. These ideas are discussed further in Chapters III and IV.

Chapter III

THE LANGUAGING PROCESS

In the model of the development of auding and reading we are constructing, the concept of languaging is central; therefore the present chapter focuses on this concept.

As defined in Chapter II, languaging is the "representation of conceptualizations by properly ordered sequences of signs." Although languaging involves both conceptualizations and a system of signs and rules, when "language" is used as a noun it refers only to the "system of conventionalized signs and rules for selecting and sequencing these signs." That is, the conceptualizations are outside of the language itself. It should be noted that this system of signs and rules can be manifested in a variety of ways or "modes." Spoken language is one mode, written language another; other modes include sign language and braille. There are also, of course, a great many variants in each of these modes—that is, different spoken, written, and sign languages.

The concept of languaging being developed here has been strongly influenced by the computer simulation work of Schank (1972). The terms "conceptualizations" and "conceptual base" are from his work. The conceptual base contains basic elements and relations which are used to form conceptualizations. In turn, these conceptualizations may be communicated to others by being expressed in some form of language. Thus, languaging is a process for representing conceptualizations in such a way that communication may occur.

The development of language refers to the child's acquisition of skill in representing his conceptualizations in language. Therefore, for languaging to be possible, the child must first acquire a conceptual base and some skill in conceptualizing, and then he must acquire a system of signs and rules for sequencing these signs (i.e., a language) for communicating his conceptualizations to others.

In the remainder of this chapter we will first attempt to clarify the notion of a conceptual base. Then we will briefly view the beginning steps of a child's acquisition of a conceptual base. This will provide a background for a discussion of the child's acquisition of the ability to represent or realize his conceptualizations in spoken language, and to understand the conceptualizations others represent in their speech (i.e., to aud).

THE NATURE OF THE CONCEPTUAL BASE

In Chapter II we pointed out that the conceptual base is not part of the language system; rather, it is a part of our memory, consisting of abstract elements and relations among elements used for conceptualizing. In other words, the conceptual base is the storehouse of raw materials used to build conceptualizations or meanings. Exactly how these raw materials should be construed is problematical. Since they are abstractions, they should probably be construed according to the particular context in which they are to be used. Thus, for the present model, we can simply assert their existence and let it go at that.

However, other investigators are attempting to produce computer programs that will simulate a variety of human languaging and conceptualizing tasks. In such cases, it is necessary that the abstract constructs of conceptual base elements be given explicit formulation—otherwise the computer will not perform. One attempt to explicitly describe the conceptual base elements for computer simulation of languaging and conceptualizing processes will be reviewed briefly to lend substance to what is, in fact, a very abstract concept. It is important to remember that, although we must use language to describe them, the conceptual base elements are *not* part of the language system.

The research to be touched upon here is that of Schank (1972, 1973). Other approaches to very similar problems can be found in Anderson and Bower (1973, particularly in their chapter on the structure of knowledge); Rumelhart, Lindsay, and Norman (1972); and Lindsay and Norman (1972, pp. 386-401). All of these approaches have been influenced by Fillmore's (1968) work on case grammars.

Schank divides the elements of the conceptual base into four types: (a) picture producers—those ideas and thoughts that are represented in spoken language by nouns; (b) basic acts—relations that are represented in spoken language by verbs; (c) picture aiders; and (d) action aiders. Both picture and action aiders are realized in spoken language by various modifiers. The elements (in Schank's view) of the conceptual base can thus be categorized as nominals (thing elements), actions (act elements), and modifiers (attribute elements).

The relations (which Schank calls "conceptual dependencies") enable the combination of these elements to form conceptualizations. Two fundamental relations are *agent-action* and *action-object*. Although either of these pairs may be realized in language, often they are combined to form an *agent-action-object* conceptualization. This would most commonly be represented in the English language by a subject-verb-object syntactic form (e.g., John hit the ball). It is important to note, however, that the same conceptualizations can also be realized in language in other forms (e.g., the ball was hit by John; hitting the ball was what John did) and even in other words with only slight changes in meaning (e.g., John struck the ball with a bat). The point is that it is the conceptualization and not the language which is the primary and salient factor in the various representations.

Examples of other conceptual dependencies and how they might be realized in the English language are:

Conceptual Relation	Language Representation
Set member - Set	Lassie is a dog.
Subset - Superset	Dogs are mammals.
Object - Location	The book is on the table.
Possessor - Object	John's book.
Event - Time	He left yesterday.
Event - Causer	He spilled the milk.
Object - Modifier	The picture is pretty.
Action - Modifier	He ran quickly.

Of course, a single complex sentence may have many of these relations in its underlying conceptualizations. Also, this list is not meant to be complete; not all possible conceptualizations are included. However, Schank and others who work in this area believe that a complete list of relations would not be overwhelmingly large. Whether or not this is so remains to be seen. In any event, for present purposes the relations mentioned provide concrete examples of one type of approach currently being used to operationally specify the elements of an abstract conceptual base, and to specify the relationships among these elements and the signs and syntactical rules for realizing (representing or expressing) conceptualizations formed from these elements in the spoken language system.

The idea that the formulation of conceptualizations is the primary goal of languaging is suggested by several studies which show that, when people aud or read, the original form of a sentence is stored only for the short time necessary for comprehension to occur. Then, once a semantic interpretation (i.e., a conceptualization) is made, the meanings, not the linguistic forms, are retained in memory (e.g., Sacks, 1967; Bransford and Franks, 1971; Bransford, Barclay, and Franks, 1972; Bransford and McCarrell, 1972; Perfitti and Garson, 1973). Thus we consider that the auder or reader formulates conceptualizations from spoken or written sentences. These are then integrated with previous knowledge in long-term memory, and an organized base of conceptual elements is formed in memory. Later on, these elements may be retrieved, during the process of conceptualizing, to form the basis for the production of new sentences by languaging.

THE ACQUISITION OF THE CONCEPTUAL BASE

By our way of thinking, the ability to form conceptualizations, a basic form of cognitive ability, must appear before language can appear. Piaget's work (*cf.*, Flavell, 1963; Beard, 1969) provides the best ideas on the acquisition of this ability. He views the infant at birth as having only a few reflexes (such as sucking and grasping) and innate tendencies to exercise the reflexes and to organize their actions. The first evidence of the capacity to organize input appears in the development of habitual actions or responses. Well-defined, repeated sequences of actions Piaget calls action schema or schemata. Action schema are characteristic of the first stage of cognitive development, the sensori-motor stage. Later, the child begins to use symbols and becomes able to develop mental schemas.

After a schema has developed, it is applied to new objects and experiences. This process of incorporating new objects or experiences into existing schema is called *assimilation*. The complementary process of modifying schema to solve problems arising from new experiences or objects is called *accommodation*. Through the interplay of these two processes, the child assimilates new experiences into existing schemas or accommodates his schemas, by extending or combining them, to meet new situations.

The result is that the infant adapts to his environment by developing a sufficient repertoire of schema; that is, in Piaget's terms, he attains a level of *equilibrium* between his cognitive schemas and the environment. However, as the environment changes or as the child extends his range of activity, the equilibrium is disturbed; further development of the schemas or the creation of new ones is necessary to restore it. The processes of assimilation and accommodation continue to result in more schema that are better adapted to the environment, and the child continues to progress through the stages of cognitive development.

In the first 18 months or so, the infant's learning consists of developing and coordinating his actions and perceptions into organized action or sensori-motor schema. Piaget views the infant's mental life as beginning with an undifferentiated world. Gradually the child begins to distinguish himself from other persons and objects. He shows through his actions, after some progress, that he has learned that objects still exist when outside his perceptual field. He learns to recognize objects and develops some bases for conceptualizations of location. Later he is able to distinguish an action from the object of that action. He develops an ability to anticipate actions from various signs that later lead to the formation of conceptualizations of causality. These and many other achievements result in what Piaget calls sensori-motor intelligence, which, although not innate, is said to occur universally.

The child at the end of this sensori-motor stage can in some sense understand the concepts of agent, action, object, location, cause, and so forth, and has some notion of the possible relations among these. As discussed in the previous section, these are the basic elements in some of the current models of the adult's conceptual base.

Brown (1973) believes that Piaget's work provides a basis for the acquisition of spoken language. He writes: "I think that the first sentences express the construction of reality which is the terminal achievement of sensori-motor intelligence" (p. 200). Brown distinguishes three levels preceding the verbal expression (oral languaging) by the child of any part of his "construction of reality" (p. 152):

(1) The sensori-motor pattern itself is a form of action in the world.

(2) The ability to represent or think about the pattern without necessarily intending to speak about it (i.e., conceptualizing).

(3) The semantic intention to make a sentence expressive of the pattern.

The types of utterances children produce, and what they actually seem to express, will be discussed later. What is important for now is the point that, in the present model, cognitive content in the form of a conceptual base develops prior to the ability to language, via the sensori-motor information-processing activities of listening, looking, uttering, and marking (or otherwise manipulating the external environment).

This view of the primacy of cognitive development is supported by Slobin (1971, 1973), who presents evidence from studies of bilingual children. According to Slobin, when a child will learn to express a given conceptualization in language should be determined by two things: the difficulty of the underlying conceptualization and the complexity of the linguistic form necessary to express it. Bilingual children, if they do first acquire the conceptualization and then learn to express it, should be able to express it in the language in which it is linguistically less complex before being able to express it in the language that requires a more complex form. This is precisely what Slobin found.

We are subscribing to the position that cognitive development precedes languaging ability. We believe that cognitive development begins as a result of sensori-motor activity and that this development precedes any effect of language. Sensori-motor activity also forms the conceptual base for the beginning of languaging.

After the development of sensori-motor intelligence and the beginning of languaging, the child continues to attain more advanced schemas and states of equilibrium. He makes greater use of symbols and abstractions, masters the more complex aspects of language, greatly increases his vocabulary, and learns new information that gets stored in memory. Once languaging has undergone some development, it may play an important role in further cognitive development. Cazden (1972) points out that words tend to integrate otherwise separate features. For example, when a child learns that a group of objects all have the same name, he then searches for similarities in them which he would not search for if they had different labels. Gagne notes that "the preavailability of language (verbal chains) has been shown . . . to make considerable differences in the acquiring of concepts by children" (1965, p. 134).

In the present model, then, we consider that, in the developmental sequence, the child first develops a conceptual base (i.e., some types of ideas or concepts), and later acquires the ability to exchange concepts with others through the use of rules for selecting and sequencing conventionalized signs. The process of using these signs and rules we are calling "languaging." Exactly what the signs and rules are we do not know, especially in the case of non-spoken language (complex gestural sequences, bodily movements that communicate subtly, paintings that represent complex internal conceptualizations, etc.)

We do know a little about the signs and the rules for sequencing these signs in the case of spoken language, and so the next section will discuss the child's acquisition of languaging ability. Since this is a very complex topic about which books have been written, our treatment will necessarily be brief. It is meant only to provide a little more flesh for the skeletal model we are describing.

THE ACQUISITION OF LANGUAGING ABILITY

Prevalent linguistic analyses divide spoken language into three subsystems: (a) phonology—the system for producing sounds and rules for combining speech sounds to form words; (b) syntax—the system of rules for ordering words to make sentences; and (c) semantics—the system of meanings or conceptualizations. Semantics can be further subdivided into the meaning of individual words (lexical semantics) and the meaning of sentences (sentential semantics).

This section will begin with a discussion of the child's acquisition of the phonological system. Next we will consider the semantics of individual words and how the child acquires word meanings. Children's use of single words will be discussed both as holophrases (attempts to represent complete conceptualizations in single words) and as lexical units (individual units of meaning such as words) to be used in combination with other words to represent conceptualizations as sentences. Finally, we will consider the processes believed to be involved in the acquisition of syntax.

The Phonological System

In the first step toward the development of language, the child begins to reproduce the sounds (phonemes) of the language he will eventually learn. Newborns do produce sounds with their vocal apparatus, but these sounds are simply cries. Some time around the sixth or eighth week babies begin to produce a class of sounds unrelated to crying—those of cooing and mewing. By the time the infant is six months old, cooing sounds become well differentiated and he can produce many different varieties of sounds. Vowels and consonants emerge as distinct from each other.

It is now possible to describe the child's vocalizations in the same way as adult speech sounds—in terms of distinctive phonological features. In the babbling of infants at this stage linguists can detect the distinct phonemes of the adult language (Deese, 1970). It is not until this stage that the sounds produced by infants in different linguistic environments can be told apart. In the early stages it is even impossible to distinguish a deaf from a hearing child by the sounds they produce. In the babbling stage, often the child acquires the stress and intonation patterns of meaningful speech, but not the words. The result is that the child sounds like he is saying sentences in a strange language.

To elaborate, at approximately six months of age (Lenneberg, 1967) the child's initial cooing sounds change into babblings that resemble one-syllable utterances. Each of these utterances (e.g., "ma", "da", "di", or "mu") is represented as a whole tonal pattern, rather than as individually produced consonant or vowel units. Because of the limited articulatory control of children at this stage, only a small number of discernible utterances are expressed, and there is a universal similarity among these sounds. That is, they are not language or culture specific.

Out of this group of random utterances, certain sounds begin to acquire meaning for the child. These sounds are made meaningful by adults (*viz*., parents); the child initially simply produces the utterances. The words "mama" and "dada" illustrate this developmental sequence. In accord with the maturational level of the vocal apparatus, the child is capable of uttering such sounds as "ma" and "da". When these sounds are produced (being done in an unpurposeful manner), he perceives a noticeable change in his environment. His parents respond in a specific manner to these sounds, and react to them differently than to other sounds. Considered behavioristically, through the process of association (and subsequently, reinforcement) the child attaches meaning to the "ma" and "da" utterances only because his parents do so.

It is of note that many different languages use similar sounds to indicate father, for example: Spanish—papa; Russian—papa; German—Papa; Swahili—baba; Turkish—baba; Hungarian—apa; Croatian—tata (Langacker, 1967). This additionally suggests that certain single-syllable random utterances acquire meaning for the child merely because his parents choose to recognize them as meaningful. The child does not "consciously" produce (indeed, he has no concept of) individual phonemes, and then integrate them into words during the initial stages of language acquisition. He does not segment words and identify phonetic elements; rather, he acquires word patterns and structures (Lenneberg, 1967).

Up until the point when the phonemes begin to be recognizable, there is no explicit evidence that the language the child has heard has any effect upon him. However, once the utterances of children in different linguistic cultures can be distinguished, clearly the language heard has had some effect. That is, the child's listening processes have begun to affect his utterances.

The experience of listening to someone speak a totally unfamiliar language is a common one. The strange language appears to be merely a flow of sounds, virtually indistinguishable from each other, definitely not reproducible by the listener. Often one is aware that he cannot even find the boundaries between the words. In fact, Neisser (1967) points out that the flow of speech does not really have physical boundaries where we listen to them once we have learned to aud. He writes:

> When the stream of speech is displayed in spectrograms . . . it displays a rather disconcerting continuity. We think of speech as made up of successive words, and words are

> composed of successive "sounds," but such parts are by no means always obvious when a spectrogram is examined. (p. 179)

We might expect that the child has a similar experience when first encountering adult speech. Somehow he must learn to distinguish the recurring sounds of the language, and to reproduce them. Then he must learn to segment the speech flow, that is, to find the divisions between the words.

Although it is true that at least some portion of the speech the child hears is more slowly spoken, more clearly articulated, and grammatically simpler than normal adult conversation (Snow, 1972), it is not currently clear how the infant learns to produce the sounds and to segment the speech flow into words. It is known, however, that the child's listening processes must give him the ability to recognize recurring verbal sounds, and his uttering processes must give him the ability to reproduce these sounds. Perhaps they work together and he gradually approximates the phonemes by comparing the sounds he produces with those he hears, and altering the productions to obtain a closer and closer match. This problem is discussed further in Chapter IV, pp. 51-53.

Semantics: Individual Words as Holophrases

Sometime after the babbling stage, the child begins to produce utterances composed of single words. One view of these early one-word utterances is that there is a full conceptualization underlying them. The child is attempting to express what would require a full sentence; he has the cognitive capacity to conceptualize it, as well as the intention to express it, but lacks the linguistic capability. That is what is generally meant when one-word speech is called "holophrastic". This view has long been popular, having been supported by Stern and Stern (1907), de Laguna (1927; see also Brown, 1973), Leopold (1949), and numerous others.

Recently, Greenfield[1] has attempted to obtain evidence to support the idea that while children are limited to uttering single words at the beginning of language acquisition, they are capable of conceiving of something like full sentences. On the basis of the child's one-word utterance, the preceding context, and the child's actions, she has attempted to determine what it was the child intended to express. For example, one child said "fishy" on four different occasions. Greenfield interprets these four uses of the same word as each having a different conceptualization underlying it, such as those that would be expressed in the sentences: "That is a fish," "This is the fish book," "That is my fish," and "There is the fish's tank." Greenfield believes that the child is attempting to express and therefore can conceptualize nomination, possession, location, and so forth.

Although there is a great deal more evidence that the child intends to express these relations once he has advanced to two-word speech (especially the evidence from the consistent use of certain word ordering), children using one-word utterances do often seem to be expressing more than that single word; the concept of one-word speech as often being holophrastic seems to be valid.

Semantics: Meanings of Individual Words

There have been several recent studies of the acquisition of individual words, not as holophrases but as lexical units—that is, as units of meaning that can be used in building sentences. Various linguists, psychologists, and anthropologists have attempted to analyze "semantic fields" (groups of words that are in some way related). The basic idea behind these analyses is that the meanings of many words can be divided into combinations of smaller, more basic, units of meaning. These basic units of meaning are here called "semantic features." Other authors have called similar constructs "semantic components" or "markers" or "dimensions"; these labels will be considered to be synonyms for our purposes.

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[1] P. Greenfield, "Semantic Relations in Holophrasic Speech," personal communication, Stanford University, Department of Psychology, February 20, 1973.

Semantic features are not part of one's vocabulary; they are not words, but abstract, theoretical elements, postulated in order to describe the relationships between words. In attempting to clarify what these semantic units are, Katz writes:

> Consider the idea each of us thinks of as part of the meaning of the words "chair", "stone", "man", "building", "planet", etc., but not part of the meaning of such words as "truth", "togetherness", "feeling", "shadow", "integer", "departure", etc.,—the idea that we take to express what is common to the meaning of the words in the former group and that we use to conceptually distinguish them from those in the latter. Roughly, we might characterize what is common to our individual ideas as the notion of a spatially and contiguous material thing. The semantic marker (physical object) is introduced to designate that notion. (quoted by Lyons, 1968, p. 474.)

One standard example of attempts to specify semantic features is the analysis of kinship terms. This type of analysis was first attempted by Goodenough (1956), an anthropologist who was interested in comparing the kinship terms and relations of various cultures. Others who have done related studies of this semantic field include Wallace and Atkins (1960), Romney and D'Andrade (1964), and Haviland and Clark (in press).

The kinship terms of English can be defined in terms of three dimensions:

(1) Sex: male or female.

(2) Generation: defined in relation to "ego". Ego's generation = 0; one generation above ego = +1; one generation below = -1; etc.

(3) Linearity: direct = ancestors or descendents of ego; collateral = not direct.

A partial analysis of some English kinship terms would therefore appear as:

Term	Sex	Generation	Linearity
father	M	+1	Direct
mother	F	+1	Direct
daughter	F	-1	Direct
uncle	M	+1	Collateral
niece	F	-1	Collateral
cousin	M or F	0	Collateral
brother	M	0	Collateral
grandfather	M	+2	Direct

Other languages may require additional components. For example, some languages use different terms for father's brother and mother's brother, both of whom are "uncles" in English. This requires a dimension Goodenough calls "bifurcation". Other languages differentiate between older brother and younger brother; this requires a "seniority" dimension.

Goodenough considers that these five dimensions or components—sex, generation, linearity, bifurcation, and seniority—are sufficient to define the kinship terms of any language. That is, they reflect all the defining distinctions that people anywhere make within this semantic field. These dimensions thus specify the distinctions a child must learn in order to fully understand kinship terms.

It is claimed that semantic feature descriptions have some sort of psychological validity—that is, they reflect the information that is associated with the words by most people. They also express relevant generalizations about the semantic structure of the vocabulary described, such as the following:

(1) A word is semantically ambiguous if it has more than one complex of semantic features assigned to it.

(2) Two words are synonymous if their meanings consist of the same semantic features.

(3) Two words are antonyms if their meanings are identical except that the meaning of one has a component C where the other has C′, and C and C′ belong to a particular subset of mutually exclusive components. (For example, male and female. Therefore boy and girl, mother and father, etc., are antonym pairs.)

(4) If word X has all the semantic features that word Y has, and some additional ones, then word X is more specific than word Y. For example, the word *parent* has the features of *generation +1* and *direct linearity*, but it is not specified on the sex dimension. The words *father* and *mother* have all the features of *parent*, plus an additional one; therefore, they are more specific terms.

(5) Semantic feature analysis also has been used in determining the acceptability of combinations of words, since the combination of words with certain types of conflicting features is not semantically acceptable (e.g., colorless green).

An analysis of words into semantic features, then, gives us some way of dividing the information represented by a word into simpler, more basic units. These can then be used to determine the relationship of that word to other words. That is, combinations of semantic features represent the knowledge about word meanings that one needs in order to language. We now turn to a discussion of how the child acquires and uses this knowledge.

Two important questions about the acquisition of word meanings are: What meaning does the child first attach to a particular phonological sequence? and how does the child's meaning of the word develop into the adult meaning?

E. Clark (1973a) discusses a very common phenomenon in children's use of words: over-extension. The child is said to be over-extending or over-generalizing the meaning of a word when he applies that word to incorrect referents that are in some way similar to the correct referent. For example, children often go through a stage of using one name, such as "dog," to apply to all animals; others have been known to use "daddy" to refer to all men. E. Clark finds many other examples of over-extension in the diary studies of young children (ages 1:1 to 2:6) from many different language backgrounds. She writes that the accounts of over-extension of nouns " . . . are remarkably alike and consistently report similar findings. As a result, over-extension appears to be language-independent (at least at this early stage in acquisition), and is probably universal in the language acquisition process." (pp. 22-23)

E. Clark offers the "semantic features hypothesis" to explain this phenomenon. This hypothesis states:

> When the child first begins to use identifiable words, he does not know their full (adult) meaning: he only has partial entries for them in his lexicon. . . . Thus, the child will begin by identifying the meaning of a word with only one or two "features" rather than with the whole combination of meaning-components or features that are used criterially by the adult. The acquisition of semantic knowledge, then, will consist of adding more features of meaning to the lexical entry. . . . (pp. 13-14)

The features young children use criterially to define words are classified by E. Clark into categories such as movement, shape, size, sound, taste, and texture. She presents tables of over-extensions found in the diary studies based on features in each of these categories.

The following example shows how the gradual acquisition of the meaning of a word can be described in terms of semantic features. This particular example also serves the purpose of showing that the general idea is not new, only the terminology. It is from Locke (1690):

> Words, in every man's mouth, stand for the ideas he has, and which he would express by them. A child having taken notice of nothing in the metal he hears called "gold" but its bright shining colour, he applies the word "gold" only to his own idea of that colour, and nothing else . . . Another, that hath better observed, adds to shining yellow great weight: and the sound of "gold" when he uses it, stands for a complex idea of a shining yellow and very weighty substance. Another adds to these qualities fusibility: and the word "gold" to him signifies a body, bright, yellow, fusible and very heavy. Another adds malleability . . . (Book III, ChII, Section 3)

Locke describes these as possible differences among people, but for our purposes this description can be viewed as the acquisition of the meaning of "gold" by one person. This can be traced by the following progression of the acquisition of semantic features:

gold: Bright & Yellow
gold: Bright & Yellow & Heavy
gold: Bright & Yellow & Heavy & Fusible
gold: Bright & Yellow & Heavy & Fusible & Malleable

It is of interest that this acquisition proceeds only by the addition of components. Since each additional component serves to further narrow the meaning, this progression moves from a general meaning, which is over-extended, to a more specific one. Sometimes children also attach incorrect additional features to the meaning of a word. For example, suppose the child's first exposure to the word "gold" was in relation to gold coins. He might then come to attach the feature circular to "gold" in addition to whatever other features he has acquired. This would result in "under-extension." The child's meaning would be too specific and there would be gold things he would not call "gold." Piaget (1928) finds that many children think the term "brother" can refer only to children, not to adults. This is another example of under-extension.

This phenomenon is not as noticeable as over-extension, since over-extension results in children applying names to incorrect referents, while under-extension generally just results in the child not naming something; mistakes are more obvious than omissions. However, it seems to be true that word meaning acquisition more often goes from general to specific meanings, rather than vice versa.

Locke (1690) believed that the basic units forming the ideas expressed by words have some sort of psychological primitiveness. He referred to these as "simple ideas" and believed that these could be recognized by the prelinguistic child. Those categories of features E. Clark describes (shape, size, taste, etc.) are clearly derived from the child's perception of the properties of the objects in his environment. These are further discussed in E. Clark (1973b). Bierwisch agrees and writes of the minimal units of meaning he calls components:

> They are not symbols for physical properties and relations outside the human organism, but rather for the internal mechanisms by means of which such phenomena are perceived and conceptualized. This leads to the extremely far-reaching, though plausible, hypothesis that all semantic structures might finally be reduced to components representing the basic dispositions of the cognitive and perceptual structure of the human organism. According to this hypothesis semantic features cannot be different from language to language, but are rather part of the general human capacity for language. (1970, pp. 181-182)

What Bierwisch is stating has been called the "universal primitives hypothesis." E. Clark looks for clues about the kinds of semantic features that might underlie early word acquisition in studies of the development of perception in infants. She cites studies reviewed by Gibson (1969), such as those of the infant coming to recognize faces, as evidence that perceptual development begins with the isolation of single perceptual features and proceeds to the use of configurations of features. Gibson summarizes the work on infants' recognition of faces:

> Development seems to proceed from simple contours to differentiated features to structural relations or patterns to unique patterns of individual faces and finally to higher order properties invariant over different individual faces. (1969, p. 347)

E. Clark believes that this type of development of looking is recapitulated when the child begins interpreting his perceptions to use them in attaching a meaning to a word. She writes:

> The child therefore begins by using a single general feature, such as shape or contour, and considers that to be the "meaning" of some term. As he becomes compelled to differentiate more meanings, he can no longer simply use a single perceptual feature: he must begin to use more than one and eventually will encode the information from a bundle or combination of features. (1971a, p. 71)

Both E. Clark (1971a, 1973a) and H.Clark (1970, 1973) apply the semantic feature hypothesis, not only to nouns, but also to relational terms. E. Clark (1971b, 1973a) has also attempted to apply it to verbs, as has Kleiman (1973). There are many additional difficulties in trying to define the semantic features of verbs, so these will not be discussed further.

As an example of relational terms, the finding of Donaldson and Wales (1970) that three-year-olds often interpret "less" to mean "more" is useful. H. Clark (1970) claims that "less" and "more" have a common feature, which he calls *+Amount*. When the child is confusing the two words, he has only this feature attached to both. Later, to differentiate them, he must learn to attach a feature Clark calls *+Polar* to "more" and *-Polar* to "less." H. Clark (1973) also has done an excellent, highly detailed analysis of children's acquisition of terms designating space and time. He also details how the child's perceptions influence the acquisition of these terms:

> The thesis of the present paper is that the child acquires English expressions for space and time by learning how to apply these expressions to the *a priori* knowledge he has about space and time. This *a priori* knowledge is separate from language itself . . . . The knowledge, it will be argued, is simply what the child knows about space given that he lives on this planet, has a particular perceptual apparatus, and moves around in a characteristic manner . . . and in this sense it is "innate." (p. 2)

In our view, then, the child learns the meanings of words one piece or semantic feature at a time. The features which the child picks out as defining are determined largely by his perceptual and cognitive processes. Viewing the child's acquisition of knowledge of the meanings of individual words in terms of semantic features enables one both to account for data from the relevant diary and experimental studies and to see how this step in the acquisition of languaging competencies is closely tied to early perceptual cognitive abilities. The next question is how the child begins to put words together to form meaningful sentences; this leads to the following section on the acquisition of syntax.

Acquisition of Syntactic Knowledge

So far we have discussed some of the child's first steps in language acquisition, including the production of the sounds of the language and the association of certain sequences of these sounds with particular semantic features. The next step for the child is to begin putting words together into ordered sequences—to produce utterances that have syntax. In order to do this, the child must, in some sense, learn the rules for ordering the signs of the language. Of course the child is not consciously aware of these rules, but neither is the adult. The rules are a way of characterizing or describing the knowledge the child must acquire in order to produce grammatical sentences. They thereby enable us to discuss this knowledge and its acquisition. The actual form of the knowledge within the child's brain is unknown, and probably unknowable.

Children's first multi-word utterances usually consist of two words. Children at this stage use the high-information words as "contentives" (nouns, verbs, and adjectives) in their speech, but not the low-information words or "functors" (such as articles, prepositions, auxiliaries). They also do not use the inflections that mark tense, number, and so on, in adult English. Brown and Fraser (1963) have proposed the term "telegraphic" to describe children's two-word speech, as well as the slightly more advanced speech. They note that the child uses the same types of words that adults retain when each word "costs"—as when sending a telegram.

This section begins with a discussion of the ~~standard views~~ of the stage of two-word speech—pivot and open classes. However, we will note some weaknesses in this type of analysis, the most important of which is that it considers only the *forms* of the child's utterances, while neglecting the *meanings*. Therefore we then look at some of the recent work on the child's attempts to represent basic underlying conceptualizations by his speech. Next we briefly discuss the child's acquisition of various grammatical morpheme factors and inflections that "modulate" or further specify the meanings of his speech. We then go on to more advanced syntactic forms, using the stages in the acquisition of the rules for forming negative sentences as an example. Finally, we look briefly at an important but unanswered question: What processes might account for the acquisition of syntactic knowledge?

Pivot and Open Classes. Children's syntactic forms, especially those first attempts to put words together to form more complex utterances, have been extensively studied in recent years. The child's first structured utterances generally consist of two words; he produces forms such as "this toy" and "mommy eat." Braine (1963) and others (Miller and Ervin, 1964; Brown and Fraser, 1963) have proposed that the child divides words into two different classes. One is a small set of frequently occurring words; in the corpora of children's utterances on which this analysis was originally based, these words occurred only in combination with other words, and generally preceded them. This class, which includes such words (at least for some children) as *see*, *get*, *bye-bye*, *more*, and *no*, are called "pivot" (P) words. The second is a large set, each member of which appears infrequently. This set of "open" (O) words consists mainly of words that are nouns or verbs in adult English.

Braine (1963) thought that the majority of the child's sentences (i.e., complete utterances) could then be characterized by a few simple "rewrite" rules:

(1) $S \rightarrow O$ [read as: sentence can be rewritten as open words]
(2) $S \rightarrow P+O$ [read as: sentence can be rewritten as pivot plus open word]
(3) $S \rightarrow O+O$
(4) $P \rightarrow$ [see, pretty, bye-bye, no, more . . .]
(5) $O \rightarrow$ [boy, mommy, sleep, milk, broke . . .]

These rules tell us that a sentence for the child can be: (a) a single word from the open class (e.g., "milk"); (b) a pivot class word followed by an open class word (e.g., "see boy," "bye-bye mommy"); or (c) two open class words (e.g., "mommy sleep"). Rules 4 and 5 list some of the members of the pivot and open classes; these serve as the final replacement elements to be substituted for the P and O in Rules 1 to 3. There also turned out to be a very small class of pivot-like words that occurred in the final position of the children's two-word utterances. Therefore the pivot class was subdivided into P_1 and P_2, and Rule 2 was replaced by two rules.

(2a) $S \rightarrow P_1 + O$
(2b) $S \rightarrow O + P_2$

Recent work has uncovered some significant weaknesses in the pivot and open classes description of two-word speech (this evidence against pivot-open analysis is reviewed by Brown, 1973, pp. 97-111). Bloom (1970) has shown that pivot and open classes are not found in the speech of all children learning English. Now that more data have been collected against which to test them, the rules simply do not fit the data; pivots occur alone and in combination with other pivots, sentences longer than two words occur often and cannot be accounted for, and there is distributional evidence that suggests that children at this stage are using more than two word classes. Also, much data from children learning languages other than English cannot be characterized in terms of two classes of words (Brown, 1973). The most important criticism is that the pivot and open characterization of child speech is a superficial one which underestimates the child's knowledge (Bloom, 1970). That is, it does not consider what the child is attempting to communicate, but merely deals with the order of the words he produces. We will now turn to some recent work which does consider what the child is attempting to communicate.

The Child's Representation of Underlying Conceptualizations. The more recent work which includes studying the conceptualizations underlying early speech is discussed in detail by Brown (1973). These studies apparently indicate the direction of inquiry in the field for at least the next few years; so far, however, they have dealt only with very early syntactic forms, primarily those of children in what Brown has designated as Stage I. These stages are defined quantitatively by the mean-length-of-utterance (MLU), measured in morphemes. The maximum MLU of Stage I is 2.00. The "ideal value" for the MLU at Stage I is 1.75, and for Stage II, 2.25. It should be noted that although Brown's stages are not "true" stages in the sense of being necessarily qualitatively different from each other, they are useful for avoiding the confusions resulting from grouping children by age, since children of the same age may be in very different stages of language acquisition.

In order to determine what the underlying conceptualizations of the child might be, a method which Brown calls "rich interpretation" is used. This method involves the researcher, with carefully obtained information about the context of the child's utterances, deciding what the semantic roles of the words might be—which are agents, objects, actions, modifiers, and so forth. The standard example of the usefulness of this method comes from Bloom (1970), who reports the same child saying "Mommy sock" on two occasions. The context of one instance inplied that the child was designating a genitive relation—"Mommy's sock," while the other implied an object-*agent* relation—"Mommy is putting Kathryn's sock on Kathryn."

There are hazards involved in this method; with young children there is generally no way of knowing whether the rich interpretations are correct. However, the evidence, outlined by Brown (1973), supports the idea that rich interpretations are reliable. It should be noted that this evidence is largely based on the child's consistent use of word order and therefore does not support the extension of this method to one-word speech. These rich interpretations are not the same as the "glosses" or "expansions" that parents provide. Such things as tense, progressive aspects, the definite-nondefinite distinction, and temporal relations are not attributed to the child's underlying conceptualizations, since there is no evidence from the child's speech and actions that these are understood. Only the basic conceptualizations, which are suggested by the child's ordered strings of words and his actions, are attributed to him.

Brown (1973, pp. 187-198) offers a tentative list of the "major meanings of Stage I." He believes that this list represents all of the different types of meanings that the child at this stage is capable of conceptualizing and then realizing in linguistic form. Brown divides the list of meanings into three "operations of reference" and seven "semantic relations." For our purposes, all ten can be considered different types of conceptualizations. These ten are: (a) nomination, which is simply naming a referent (most commonly realized in language by children in Stage I as "This + Noun"); (b) recurrence, which either comments on or requests the "recurrence" of a thing, person, or process (the most common realization takes the form of "More + Noun); (c) nonexistence, which includes both absolute nonexistence and nonexistence in the context of the utterance (examples include "No more noises," "All gone egg," "Dog away"); (d) agent and action; (e) action and object; (f) agent and object; (g) action and location; (h) entity and location; (i) possessor and possession; (j) entity and attribute. As already discussed, Brown believes that these conceptualizations derive from sensori-motor intelligence. He writes:

> . . . a rather short list of semantic propositions and relations . . . will encompass the nonlexical or compositional meanings [i.e., the underlying conceptualizations] of the majority of all multi-morpheme utterances produced by the Stage I children . . . . these meanings seem to represent linguistically the sensori-motor intelligence which develops, according to Piaget's research, in the 18 months or so which normally precede Stage I. (1973, p. 64)

The Stage I child realizes these conceptualizations in language in a direct way. Examples have already been given of how the three operations of reference (a-c) are realized. The seven semantic relations are realized in speech simply by replacing each element by a word that represents what is "playing" that semantic role. The order of the conceptualization is maintained. For example, in an utterance representing an agent + action conceptualization, the agent will always precede the action. Even much more advanced children express their conceptualizations, and assume that others express theirs, in a fairly direct way. For example, children have difficulty in understanding reversible passive sentences, since they disrupt the expected agent-action-object order; given the sentence "The girl was hit by the boy," children often incorrectly understand it to mean that the girl hit the boy (Slobin, 1966).

As the child advances, the "realization rules" become increasingly complex. By the time he reaches the adult stage, he has many possible ways of representing any conceptualization in language; there is no longer anything approximating a direct mapping between sentence and conceptualization (although, of course, the adult can use simple language, as he might when speaking to a young child). There are a great many mysteries with complex language, both on how to describe the realization rules and on how the child learns them.

The realization rules that convert the propositions and relations into language have been characterized in several ways. Bloom's (1970) characterization is a transformational grammar that has a directly semantic base structure. That is, instead of formulating a base structure in terms of abstract linguistic entities, and then invoking some sort of "semantic interpreter" (as in Chomsky, 1965), the deep structure in Bloom's model takes the form of an underlying conceptualization. This leads to problems since it implies that the conceptualization is linguistic to begin with.

Schlesinger (1971) presents a set of realization rules that are not influenced by transformational linguistics. He looks for rules that could convert conceptualizations to sentences. He offers a formal treatment for only the simpler steps of converting "intention-markers" (as he calls the underlying conceptualization) to sentences. An example will suffice to give an idea of the outlines of his model. The following one is taken from Brown's (1973, p. 112) discussion of Schlesinger's model. Consider the sentence "John catches the red ball." The intention-marker for this sentence would include the following conceptions and relations:

red	is attribute of	ball
(the (red ball))	is object of	catches
John	is agent of	(catches (the (red ball)))

The intention-marker is operated upon by the following realization rules:

R1 Att(a,b) → N (adj a + Nb)
R2 Ob (a,b) → V (Vb + Na)
R3 Ag (a,b) → S (Na + Vb)

Rule R1 may be expanded to read: When *a* is an attribute of *b*, then *a* precedes *b* and *a* is an adjective, *b* a noun, and the combination itself a noun. Rule R2 would read: When *a* is an object of *b*, then *a* follows *b* and *a* is a noun, *b* a verb, and the resultant combination itself a verb. Rule R3 reads: When *a* is an agent of *b*, then *a* precedes *b* and *a* is a noun, *b* a verb, and the result is a sentence.

This example of some rewrite rules provides a rough idea of some of the things the child has to learn. What "rules" the child actually uses is not known. As the child acquires more advanced languaging abilities, the mysteries increase. Rather than get further involved in the unknown, we will move on to how the child begins to make finer distinctions in his speech—to "modulate" the meanings of Stage I with grammatical morphemes.

The Acquisition of Grammatical Morphemes. We have noted that Stage I children's speech has been called "telegraphic," since it includes contentive words but not function words or inflections. Stage II (defined by a MLU of 2.00 to 2.50) is characterized by the appearance of some of the function words and inflections. These do not have meanings in isolation, but modify the meanings of Stage I speech. They add such things as number and tense, mark whether nouns are specific ("*the* book") or nonspecific ("*a* book"), designate distinctions such as that between *in* and *on*, and play other such roles.

Brown (1973) writes that what is acquired in this stage is knowledge of the "grammatical morphemes and the modulations of meanings." He discusses 14 grammatical morphemes, and presents evidence that the order in which the child begins to use them appropriately is determined by the semantic and grammatical complexity of the morphemes, not by how frequently the child hears them. The complexity measures are based on linguistic analysis and we will not get involved with them here. Brown's data in support of this claim come largely from corpora of the spontaneous utterances of several children. It has been shown that comprehension generally precedes production (Fraser, Bellugi and Brown, 1963); children in experimental situations show some understanding of the grammatical morphemes (e.g., picking the picture of "the cows" as "the cows" correctly) before they use them in spontaneous or elicited speech.

Berko (1958) did an important study of children's use of the inflections marking plurals, possessive past tense, present progressive (e.g., hitt*ing*), and third person singular (hits) verbs. This study clearly showed that children induce rules for using these, since they were able to apply them to made up words to produce such forms as "wugs", "zebbing", "bik's", "spowed", and "loodges". Berko used a technique of elicited productions. For example, she would point to a picture of a funny, bird-like creature and say to the child: "This is a wug." She would then point to a picture of two of them and say: "Now there are two of them. There are two_____?" If the child supplies the missing word with a plural marker ("wugs"), as most of the children did, he has mastered the rules for forming plurals. The same induction of rules is obvious in spontaneous speech when the child over-generalizes his use of the rules and produces forms he probably never heard, such as "sheeps," "comed," "gived".

More Advanced Syntax. The rules for plurals, past tense, and so forth, are relatively simple. The rules for characterizing all the knowledge of the language an adult knows are very complex; no linguist has yet been able to describe them completely. Chomsky (1957, 1965) has attempted to write a set of rules which designate how all grammatical sentences of English can be "generated" or built up by a formal, step-by-step procedure. Two types of rules are used: "rewrite" or "phrase-structural" rules, which operate hierarchically and generate a base or "deep" structure; and "transformational" rules, which operate on the entire deep structure and transform it into the actual sentence or "surface" structure. Transformational rules enable linguists to account for the similarities among active, passive, negative, question, and other forms of the same basic sentence. Transformational rules also enable embedded sentences and conjunctions to be generated.

There have been quite a few attempts to write comprehensive "grammars" (systems of generative rules), of the type developed by Chomsky, that could characterize a child's speech at various stages, including the more advanced ones (Braine, 1963, 1971; Miller and Ervin, 1964; Bloom, 1970; Bowerman [see Brown, 1973]; Brown, Cazden, and Bellugi, 1969). These researchers have attempted to describe the syntactic structures of children's utterances at a given stage by formulating a set of rules that could generate equivalent structures. The set of rules is considered to reflect the child's knowledge. As the child progresses, some rules are modified, others added, and the grammar gets reorganized so that each stage is characterized by a different set of rules. It is important to note that these grammars have generally been concerned only with syntax and not with meanings. The child's language has generally been viewed as advancing from two-word speech to a stage when the child begins to use combinations of words that can be generated by relatively simple phrase-structural grammars. This phrase-structural grammar becomes more complex and eventually becomes reorganized in certain ways. The child is now viewed as adding transformational rules to his knowledge. He is approaching adult grammatical competence.

The work of Klima and Bellugi (1966) on tracing children's acquisition of the rules for negation in English clearly illustrates some of these steps. (The authors also trace the acquisition of questions in a similar way, but negation provides a sufficient example by itself.) The acquisition of negation is divided into three stages:

In the first stage, negative markers ("no" or "not") are simply attached to either the beginning or the end of the utterance to be negated. There are no negatives within the utterance, nor are there any auxiliary verbs in the child's speech. Examples at this stage include: "Wear mitten no," and "Not a teddy bear."

In the second stage, the negative can be put within the utterance, between the subject and predicate, and may be attached to an auxiliary verb. Examples without auxiliaries include: "He no bite you," and "He not little." Examples with auxiliaries include: "I don't want it," "I can't see you." The auxiliary verbs occur only when accompanied by a negative, and do not appear in questions or declarative utterances at this stage. Therefore, "can't" and "don't" are considered to be lexical representations of negative verbs; for the child, they do not consist of two separable words. The child's negative utterances at this stage are generated by Klima and Bellugi by a simple phrase-structural grammar.

In the third stage, the auxiliaries begin to appear in declarative sentences and questions as well as in negatives. Therefore they are now considered as separate from the negative elements, and "can't", "don't", and so forth each consist of the combination of two words that are represented separately in the lexicon. That is, the child's rules have become reorganized—he has realized that the same auxiliaries can appear in various ways. The child's negative forms have also advanced in other ways and it is now necessary to incorporate transformational rules to generate them.

We have seen, then, that the child progresses from one-word utterances to simple, ordered utterances, consisting of two words that directly reflect the underlying conceptualization. He learns to modify the basic meanings by using function words and grammatical inflections. Then he begins to represent more complex conceptualizations and to use longer, more complex sentences. His knowledge both increases and becomes reorganized. Eventually, he acquires various ways of representing any conceptualization (e.g., agent-action-object can be represented by either a passive or an active sentence). His languaging abilities are now quite powerful—a great many things can be clearly expressed and fine distinctions and complex ideas can be communicated. However, the means of languaging are complex; there is a very indirect mapping of conceptualization to language and back again. A great deal of linguistic knowledge has been acquired. How this knowledge is acquired will be considered next.

The Processes of the Acquisition of Syntactic Knowledge. Those descriptions of the stages a child progresses through before acquiring adult language abilities do not provide any ideas of the *processes* underlying the acquisition of syntax. How does the child acquire knowledge of the rules for selecting and sequencing the signs of his language?

Brown and Bellugi (1964) write of "three processes in the child's acquisition of syntax." These are further discussed by Cazden (1972). Two of the processes are child-adult interactions involving language. The first is imitation with reduction—the child imitates the adult's utterances in an abbreviated form while maintaining word order. The complementary process is imitation with expansion—the adult imitates the child's utterance, but expands it to include those elements left out by the child. They point out that while these processes occur, the child is very rarely given direct feedback as to whether or not his utterances are grammatically correct. Generally, young children are given negative feedback only when the utterance is semantically incorrect within its context, or when it is not understandable. Brown (1973) also points out that the frequency with which a child has heard a linguistic structure used has less of an effect on when he will acquire it than does its semantic and grammatical complexity. The third process discussed by Brown and Bellugi is the least understood, as well as being the key to syntactic development:

> The processes of imitation and expansion cannot teach more than the sum total of sentences that speakers of English have either modeled for a child to imitate or built up from a child's reductions. However, . . . all children are able to understand and construct sentences they have never heard but which are nevertheless well-formed, well-formed in terms of general rules that are implicit in the sentences the child has heard. Somehow, then, every child processes the speech to which he is exposed so as to induce from it a latent structure (1964, p. 143).

Brown and Bellugi view this induction of the latent structure to proceed by the progressive differentiation of syntactic classes, working simultaneously with an integrative process which enables the child to learn to correctly combine elements of the different classes.

Slobin (1971, 1973) has attempted to derive from his cross-cultural research "operating principles" that the child may be using in beginning to process his language.

These operating principles are said to "guide the child in developing strategies for the production and interpretation of speech and for the construction of linguistic rule systems." They, therefore, would seem to provide some sort of link between listening and auding processes. However, Slobin's operating principles seem more like descriptions of what children across various languages appear to do, rather than explanations of how they acquire language. For example, Operating Principle F: "Avoid exceptions," reflects the common observation of children over-generalizing linguistic rules and thereby producing such forms as "sheeps" and "goed." Other operating principles include: "Pay attention to the ends of words," "Pay attention to the order of words and morphemes," "Avoid interruption or rearrangement of linguistic units," and others.

These operating principles do seem to provide a description of what children do. However, the question of how the child comes to know these principles remains. Some would claim that these principles, which are used only for language, reflect innate knowledge of the human infant. Claiming that the child has complex, language-specific innate knowledge is fairly common in the field of developmental psycholinguistics (e.g., McNeill, 1970). However, often this is equivalent to saying that, since we do not understand the processes of syntax acquisition, we can "account" for it by postulating innate knowledge. This is avoiding questions rather than attempting to answer them.

Slobin also presents a very general principle in regard to the relationship of semantic intentions or "functions" and the means or linguistic "forms" of expressing them: "New forms first express old functions, and new functions are first expressed by old forms" (1971, p. 317). This principle appears to fit neatly into Piaget's processes. First the child acquires a function, that is, a conceptualization which he intends to express. Then he acquires the linguistic means of expressing it, the form. Soon the child acquires a new function. Not yet having the form necessary to express this new function, he uses the old form. However, the old form is not satisfactory for expressing the new function, since others do not always understand what the child intends to communicate. That is, the new functions cannot be fully assimilated to the old forms; a state of disequilibrium exists. Therefore, the forms must develop further to accommodate the new functions and the child's linguistic abilities progress.

These processes of assimilation and accommodation, and the striving to attain a level of equilibrium, are considered by Piaget to be the basic processes involved in cognitive development. Our view attempts to fit language acquisition into the same framework. We see language acquisition as resulting from the child's interaction with his environment, and as being integrated with his other cognitive processes. It seems quite plausible that there are similar processes underlying both cognitive development and language acquisition; it seems quite plausible that assimilation and accommodation capture the essential nature of these processes. With the present state of our knowledge, this is how we view the acquisition of languaging ability.

Chapter IV

THE DEVELOPMENT OF LISTENING/LOOKING AND AUDING/READING PROCESSES

In this chapter we ~~will~~ elaborate upon the distinctions made in Chapter II between hearing, listening, and auding, and between seeing, looking, and reading. First we will consider the BAPs (basic adaptive processes) of hearing and seeing as processes that are innately given to permit the person to utilize structural information in the environmental energy flux. Next, we will consider the role of BAPs for memory and attention in the emergence of listening and looking as processes for obtaining information relevant to an individual's cognitive demands. Then we will consider the development of auding and reading as specialized listening and looking activities, pointing up certain similarities and differences between these two languaging processes.

HEARING AND SEEING: THE CONTINUITY OF ORGANISMIC AND ENVIRONMENTAL INFORMATION

Our way of viewing the environment and the person's mental life is heavily influenced by the work of James Gibson (1966). Indeed, much of what follows is no more than our paraphrase of his thinking. Yet, we are never too certain as to where his influence interacts with the influence of other writers (e.g., his wife, E. Gibson, 1969; Hochberg, 1970; Neisser, 1967; Blumenthal, 1970) and our own thinking to produce the statement we present. Therefore, having acknowledged our debt to these exceptional thinkers, we will simply proceed without always citing whose thought is involved.

We consider that the earth is contained within a "sea of energy." This energy flux includes electromagnetic energy and mechanical energy which contain the potential for stimulation of living organisms. That is to say, the different forms of energy are there whether or not an organism has the requisite sensory apparatus for detecting them. Furthermore, within each form of energy, there are many structural features that are shaped by the objects and events in the earth's environment. For instance, mechanical energy is structured into many forms by the vibrations produced by events such as landslides, bird calls, wind blowing through trees, and human voices. Electromagnetic energy radiated by the sun is structured by being filtered, absorbed, diffused, and reflected by the gases, liquids, and solid objects making up the earth's atmosphere and surface.

A variety of structure in the "energy sea" may be assumed to have existed since the beginning of the earth. Thus, for instance, mechanical and electromechanical energy have existed; vibrations characteristic of certain events have occurred; electromagnetic energy has been structured in characteristic ways over the eons (e.g., differences in the brightness of the earth and the sky; night and day; reflectance from various surfaces—planes, curvatures). Into this energy flux living organisms emerged, all of which used some of this energy for survival. We imagine that over the eons, organisms evolved that could utilize more and more of the structural information in the environment to their survival advantage. Thus, we consider that organisms evolved separate sensory receptors for detecting mechanical and electromagnetic energy because this served some purpose (e.g., better survival). Higher forms of evolution, including man (to jump ahead a few million years!), have, by this way of thinking, developed the various sensing and perceptual systems that they have in order to utilize more and more of the structural information in the energy environment for survival purposes. To state this somewhat differently, the thought is that organisms, including man, have developed in such a way as to make use of the structural information in the earth's environment. Regarding man, this means that eyes and ears developed not in some reactive way to the stimulation of light and sound, but rather that mutations occurred with sensitivities to more and more of the structure in the environment and were better able to adapt and adjust to the environment (i.e., they survived).

Today, man has eyes, ears, and neural systems particularly suited not just for the detection of mechanical or electromagnetic energy, but for the extraction of structural information from acoustic and optic displays. For example, the fovea of the eye contains thousands of closely packed receptor cells that can scan the structured light falling on the retina and make fine resolutions between the details in the structure. The basilar membrane of the ear is finely tuned to be responsive to mechanical vibrations and temporal patterns of mechanical energy. It is important to bear in mind that these capabilities evolved and exist today to permit ears to construct a higher fidelity mental representation (percept) of the environment and hence to contend with the environment more effectively. Thus, we seek environmental information to enhance the fidelity of our internal representations. The eye and the ear as we know them have evolved as a consequence of the evolving organism's need for information, not as mere energy detectors—although they do this as a necessary, but clearly insufficient, part of construing the environment. The enhancement of the percept—not simply reacting to energy—we regard as the major factor in the evolution and functioning of the eyes and ears.

Because the eyes and ears and associated nervous system mechanisms have evolved to be sensitive to the structural information in the environment, we consider that hearing and seeing, in the neonate, act as automatic organizers of the energy flux to build a perceptual experience. By this we mean that all those processes involved in hearing and seeing are similar to the processes involved in maintaining the heart beat, the breathing process, and other vegetative processes. The difference is that hearing and seeing build perceptions—mental constructions which represent the structural information contained in the environment. Furthermore, we consider that these percepts are, themselves, the structured information produced by the operating of the nervous system. The energy changes in the nervous system (e.g., the nerve impulses) are considered as similar to the energy flux in the environment, that is, as a medium which is structured by the patterning of nerve impulses and interconnections among neurons to produce structured information in the internal environment. Hence there is continuity of the mental representation of the environment and the environment itself in the form of structured energy as information. The neonate has perceptual systems for preserving the information in the environment by appropriately structured nervous energy changes. When these patterns of energy changes involve the auditory nervous system, this is called hearing, and the result is an auditory percept; when the visual system is involved, the process is called seeing, and a visual percept results.

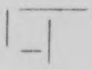
To summarize, then, in the present model seeing and hearing are regarded as passive perceptual processes; they accomplish the registration of information contained in the energy of the environment. Following J. Gibson (1966) we consider that light, in the form of waves of electromagnetic energy, or sound, in the form of waves of mechanical energy, contain structured information extractable by the eyes and ears, which, in turn, transmit information in the form of patterns of neural impulses to the visual and auditory reception centers of the brain. No conscious, mediating cognitive processing is involved in extracting and registering this information; the outcomes of seeing and hearing are automatic results of the functioning of the sensory register and brain systems. From birth, they produce some organization or percept of the environmental information. However, this production is not under conscious control of the neonate—but neither is it under control of the mature person. Rather, the person obtains control over what is seen and heard by the emergence of memory capabilities necessary to the processes of looking and listening. We need, then, to consider memory processes as precursors to looking and listening.

THE MEMORY SYSTEM

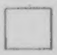
Among researchers who are studying memory processes, consensus appears to exist regarding a model of memory which contains three basic components: sensory information storage (SIS); short-term memory (STM) storage; and long-term memory (LTM) storage (Greeno and Bjork, 1973).

The SIS system stores information impinging upon the sensory receptor surfaces in the form of an "image" for very short durations of time (on the order of 300 milliseconds). The information load capacity of the SIS is relatively large; its function is to momentarily represent and store high quantities of the structural information in the environmental display in the form of an analog internal structural information display.

The "image" stored in the SIS decays rapidly, and must be recoded in some different form if the information is to be of longer lasting utility to the person. The extraction of information from SIS is accomplished by certain control processes which operate in STM. These control processes make up the activities we commonly refer to as "attending to" something. Thus, to extract information from SIS, we attend to part of the internal representation or "image" by the initiation of recoding processes. While the nature of all such control processes is not clear, one which is familiar is the transformation of sensory information into language structures; that is, we name certain features of the display. We may also add information from past experiences to part of the information in the "image" and construct a new image in STM which we "recognize" as a familiar thing or event. Thus if the following information is briefly stored in SIS:



we may recode this as:



and label it a "square". Later, if asked what we saw, we would say "a square." The important point, however, is that some active attention to the information in SIS is necessary to extract the information in SIS for further cognitive processing in STM.

Not all of the information held in SIS can be utilized in later stages of memory. Because the attending response can be given to only parts of the information in SIS, a sequence of attending responses is necessary for all information in SIS to be extracted. However, the "image" in SIS decays rapidly, and frequently this occurs before the sequential attending responses can be made. Hence some information may be lost due to lack of attention. Another problem, too, contributes to the loss of information from SIS; the STM has a relatively small information storage capacity capable of retaining only a few units or "chunks" of information.

Thus, for instance, the following list of words is difficult to recall if one reads them one after another at a rate of about one per second: the, happy, cage, open, now, bright, to, door, and, possible, yellow, see, had, that, to, canary, that, been, it, fly, was, the, left, was, away. After seven or so words, our STM capacity is approached; we need to perform a control process called rehearsal (i.e., repeating the list several times) in order to finally store the total list in LTM for subsequent recall.

However, if the list of words is rearranged as follows: "the bright, yellow canary was happy to see that the cage door had been left open, and that it was now possible to fly away," we are able to change the size of the "chunks" in STM from words to meaningful phrases and substantially increase the amount of information we can serially extract from the visual image in SIS and retain in STM for immediate reproduction. Recoding of SIS information into language information is a control process performed in STM to improve the amount of information that can be processed in a unit period of time.

Concerning STM then, we consider that STM processes are under direct control of the individual; they govern the actual flow of information in the memory system. Also, short-term memory has a relatively small capacity capable of retaining only a few units or "chunks" of information, and a storage survival duration of approximately 15-30 seconds. The retrieval of information from this temporary working memory is rapid, accurate, and reliable.

In contrast to the STM, the LTM is considered to be a virtually permanent memory store with no practical limit in terms of capacity. Through such STM control processes as rehearsal or recoding, information may be transferred from STM and retained in LTM. Information retrieval from LTM is a complicated, and sometimes unsuccessful, process which requires the activation of searching and scanning strategies in STM. It is thought that much information apparently lost is actually stored in the LTM system, but has become inaccessible (Greeno and Bjork, 1973). In the present model, LTM is referred to as the cognitive content, and contains the conceptual base and the language system as subcontents. Since these aspects of LTM have been discussed in Chapter III, we will not pursue them further at this point.

By way of closing this brief account of our understanding of the current conception of the memory system as viewed by cognitive psychologists (Greeno and Bjork, 1973; Lindsay and Norman, 1972), we see that the control processes taking place in STM act to unite structural information from the SIS with such information retrieved from LTM. Thus, the control processes (attention) deal with information coming from outside and within the person. When these control processes are brought to bear on auditory information in SIS, the listening process is defined; when performed on visual information in SIS, the looking process is defined. From this perspective then, it is clear that to better understand the nature of listening and looking, we must have a better understanding of the processes of attention occurring in STM.

THE DEVELOPMENT OF LOOKING AND LISTENING AS ATTENTIVE PROCESSES

The nature of the environmental display, the sense organs, and the neural mechanisms responsible for the internal representation (perception) of environmental information are, of course, different in looking and listening. However, beyond these display and physiological differences, the looking and listening processes are quite similar; both processes entail attention—the active selection of information from the environment for storage in SIS and its subsequent manipulation in STM to meet some cognitive requirement.

E. Gibson (1969) has identified certain developmental changes which occur in the attentional processes from childhood to adulthood:

(1) *Attention becomes more exploratory and less captive.* In the early days following birth, the child's attention seems to be reflexively "captured" by such environmental information as movement of objects, complex informational displays, sounds. Later, the child becomes apt at actively exploring visual or acoustic displays. We assume that active scanning of an environmental display occurs only after the infant is sufficiently skilled in constructing and storing internal representations in STM so that he can make use of the sequential input of information and still maintain a sense of continuity, rather than experiencing a kaleidoscopic experience of successive internal representations. Presumably, then, only after sensori-motor intelligence has sufficiently progressed to build and store internal schemata in LTM for use in organizing successive inputs does the attention "break loose" from the perceptual resonance due to the inherited capacity for hearing and seeing, and begin to operate in service to the newly formed sensori-motor schemata. Fantz (1970) has indicated that the child may begin to "look" and "listen" as early as three weeks. Also, it has been suggested (Kagan, 1970) that such infants can construct mental representations of events. This implies that they are capable of establishing cognitive structures and processing information. Such a behavioral alteration, a progression from the passive registration of information in displays to the active pursuing and processing of information, is the principal consideration responsible for the present model's differentiation between seeing and looking, and hearing and listening.

(2) *Exploratory attentive search becomes more systematic and less random.* Investigations of the visual search patterns of children (Vurpillot, 1968; Mackworth and Bruner, 1970) have revealed that the course of eye movements and construction of search strategies change with age. Young children (three-year-olds) tend to fixate a segment of a display for a relatively long time, suggesting that it takes them longer to extract the information for building an internal representation (Mackworth and Bruner, 1970). The pattern of fixations of the young child is not as oriented toward informative areas of display as is the older child's (6 years old) and adult's, nor do they show the use of efficient scanning patterns for various tasks. In part, this may reflect the young child's lack of ability to simultaneously process information from the fovea and the periphery of the eye (Gibson and Olum, 1960). Atkin (1969), using an ocular pursuit task, determined that adults had developed their visual inspection mechanisms to the extent that they could simultaneously process both peripheral and foveal information. This is an especially important skill vis-a-vis reading which we will discuss later on.

(3) *Attention becomes more selective and exclusive.* As children develop, they become better at selecting what they will attend to. They are able to "focus" attention or "concentrate" on task-relevant information. Importantly, this ability requires that the

child establish some cognitive goal, and then seek information which will achieve that goal. Selective attending is very much a problem-solving type of activity, in which external information that satisfies some cognitive requirement is sought. To selectively attend, the child has to know what type of information is needed to solve the cognitive problem. Thus, if the child is at a party and wants to selectively listen to one voice out of the clamor of a dozen voices, he or she must extract information from SIS which will contribute to the construction of a particular conceptualization, via languaging. To facilitate the extraction of this information, the child may perform an orienting movement, such as turning the head toward the speaker, which will have the effect of amplifying the particular signal over others in the SIS. Additionally, the child may make use of binaural localizations to guide the selection of the desired information from SIS. The use of orienting responses and binaural localization appear as basic abilities even in neonates (E. Gibson, 1969, p. 460), while the ability to selectively extract meaningful information obviously depends upon the child's acquisition of a conceptual base and the ability to language.

Similarly, the ability of the child to selectively attend to other than spoken language displays implies a cognitive goal, and a means of determining when the goal has been achieved. The goal may be fairly simple, such as scanning a figure to produce a recognition response, or fairly complex, such as following a conversation in a crowded room. However, regardless of complexity, it is necessary that the child be able to focus attention to limited aspects of the information in SIS, and to ignore or filter out task-irrelevant information. Thus, the efficient, goal-oriented processing of information from SIS requires the ability to ignore non-task-relevant information, as well as the selective processes mentioned above.

Inasmuch as listening and looking are simply names for attending to structural information in the auditory or visual modality, they exhibit the developmental trends described by E. Gibson (1969) and discussed earlier. There are, however, two other aspects of attention which should be noted. One is the distinction between the *focus* and *margin* of attention (Blumenthal, 1972); the other is the concept of *automaticity* of information processing (La Berge and Samuels, 1973).

Attending to informational displays may be considered as analogous to searching a display with a spotlight. The point of focus of the spotlight is bright and clear, while the area surrounding the spot of light fades from brightness to dimness to darkness. The bright spot represents the focus of attention, while the dim area represents the margin of attention. In attending to one aspect of an internal display, we are also vaguely aware of non-attended information in the margin of consciousness or awareness. Blumenthal (1972) characterizes differences between information processing in the two components of attention:

(1) In the *focus of attention* information is processed serially—there is sequential processing as the focus moves from spot to spot; there are temporal limits on how rapidly focal attention may switch, certainly no faster than 10 times per second; the information in the focus is distinct in detail and organization.

(2) In the *margin of attention* information is processed in parallel—as in the storage of information in SIS, or some other form of buffer storage; the representation in the margin is crude and relatively undifferentiated.

Neisser (1967) suggests that the information-processing activities occurring in the margin of attention are preattentive processes which serve two functions. One is to guide the focus of attention to informative aspects of the display in SIS. Thus, for instance, the eye "knows" where to move next in switching attention to scan a display because of the information analyzed by the preattentive processes. Presumably, it is the processing of preattentive information picked up by the periphery of the eye that improves with age to permit children to search displays more efficiently and effectively, as indicated above.

A second function of the preattentive processes is to guide the execution of a variety of responses without the need for focal attention. For instance, we may both drive down a road and attend focally to some thought we are having. We rarely bump into walls while walking through a building, yet we do not focus attention on avoiding the walls. The information processing needed to direct these activities is accomplished in the margin of attention, usually in an unconscious manner. That is, we are not aware of the processing done to accomplish skilled actions such as driving, walking, or reaching for things.

An important feature of the preattentive processing of information is that skilled behaviors which, in the early stages of acquisition, require focal attention to be performed may, after extended practice, be guided by preattentive processes—thus freeing the focus of attention for the performance of other activities. In this case, the performance of the former behaviors is said to exhibit *automaticity* (La Berge and Samuels, 1973); that is, they can be performed while focal attention is directed elsewhere. The achievement of automaticity in decoding during reading, and the automatic processing of information from the periphery of the eye, by preattentive processes, to guide the eyes along the lines of print in a text are major skills underlying accomplished reading. These skills will be discussed in more detail later in this report.

AUDING AS LISTENING

As indicated in Chapter II, auding is considered to be a specialized listening activity. It is defined as "listening to speech in order to language." In turn, as we have just seen, listening is the name for the process of attending to information in the auditory SIS (sensory information store) to process it for immediate use or for storage in long-term memory for later use. Thus auding is the process of extracting (attending to) the structural information in SIS, which in turn represents the structured information in speech sounds displayed in the environment.

How well information from auditory SIS gets processed depends upon factors which characterize the nature of the memory system as a dynamic information-processing system, such as the temporal parameter and load capacity of the SIS and STM, and the characteristics of attention, such as serial processing in the focus of attention and the ability to use preattentive processing (the degree of automaticity of information processing). Since these factors affect the processing of all information in the auditory system, they are called listening factors.

Obviously these listening factors will affect how well speech information is processed. In addition, however, because the system of spoken signs is arbitrary and conventional in terms of meanings, a learning process is required which may produce substantial differences among people in their ability to aud. For instance, limited numbers of verbal signs (low vocabulary) vis-a-vis a corpus of knowledge will limit the auder's ability to extract information from SIS by recoding it into meaningful conceptualizations and relating it to prior knowledge. This aspect of the information-processing task we would classify as a languaging problem embedded within and subject to the constraints of the more general process of attending to auditory information called listening. Thus we say that, while there are listening-but-not-auding activities, there are no auding-but-not-listening activities. Auding is a special type of listening.

AUDING AS LANGUAGING

In the present model we use the term languaging to refer to a general process of representing ideas by sequences of conventionalized signs for purposes of communication. The signs are considered as internal mental programs for the production of patterns of movements of muscle groups (acts) which produce structural information in the environment. The latter we refer to as the environmental, or sometimes simply external, display.

For spoken language, we consider that the signs are internal programs for the complex, coordinated patterns of movements used in speaking (i.e., abdomen, chest, and verbal articulators—vocal cords, tongue, lips, etc.). These muscular acts impart characteristic patterns of movements of molecules in the air which may be sensed as structural information in the external display by a listener/auder.

Research in speech perception (Liberman, 1970) has suggested that the movements of the articulators, and hence the movements of the molecules in the air, do not faithfully follow the internal articulatory program which the speaker uses to activate the muscle groups involved in speaking. There is a recoding (loss) of information from the formation of internal articulatory programs to the external representation of these programs in speech. That is, the speech signal does not faithfully represent the information in the internal articulatory program (i.e., the "plan" for "telling" muscle groups what to do to produce verbal signs). Rather, the speech signal loses information contained in the mental articulatory program and, hence, is said to be an encoded representation of the internal articulatory program which the speaker has formed as a language representation of a conceptualization he wishes to communicate.

Familiar evidence for the lack of agreement between the speech signal and the internal articulatory program is in the lack of ability we have in segmenting the speech stream of a foreigner speaking an unfamiliar language. There is little information in the speech stream to tell us where words begin or end. Thus, such segmenting must be done "in the head" of the language user. Additional, not so familiar, evidence of the code-like nature of speech is the finding that the speech stream does not carry any physical representation of many phonemes which are in fact "heard" by the auder (Liberman, 1970, p. 308). For instance, the syllable "da" can be segmented by a speaker/hearer as two phonemes, the /d/ consonant and /a/ vowel. But the physical acoustic stream cannot be so divided. In the physical signal, when the /a/ is removed, what is left is a chirping or gliding sound.

In auding, then, the auder presumably decodes the spoken message by use of previously acquired skill in programming articulatory movements. The languaging mechanisms for both representing and comprehending conceptualizations in spoken form are thus considered to be the same: the formation of internal articulatory programs. It is not, however, necessary that these programs be executed—that is, the programming may take place without an "execute" or "speak" command being issued. This may indeed happen during the "inner speech" of silent reading, about which more will be said later.

It is not clear exactly how the developing child learns to produce and comprehend the speech around him. We know, though, that the infant has ample opportunity to produce syllables and to listen to them immediately afterwards. Thus a feedback loop exists between the child's articulatory programming and his auditory reception. It seems likely that the child first auds his own speech. In this way, the internal articulatory programming would develop to produce certain syllabic sound patterns (i.e., structured information in the environmental display) which could then be picked up by the ear, stored in SIS, scanned by attention, and compared to the same program just used to produce the pattern of sound to obtain a match. We know in fact that children do repeatedly form the same syllables in their babbling, and so we can guess that their focus of attention may be on the structured information in auditory SIS produced by their own articulatory programs.

Thus the child may come to "seek" structured information in the environment similar to that he produces himself through articulating. If now the parents begin imitating the child, which we saw in Chapter III appears feasible, resulting in words like papa and mama, the child can analyze this structured information in terms of his own articulatory programs to find a match. While this may, in the early stages of learning, require the full focal attention of the child, with extensive practice the speech decoding skills of the child reach the level of automaticity. In fact, this may happen for the most part before the child starts using language for communication. Once these decoding skills are automatic, focal attention may then shift to the task of conceptualizing and learning the conventionalized signs for representing conceptualizations in language, as discussed in Chapter III.

By this way of thinking, learning to aud, like learning to read, involves the learning of a decoding activity—decoding the information in the speech stream into internal articulatory programs. The auder must then convert the articulatory programs into conceptualizations, which has the effect of storing semantic information in long-term memory. If rehearsal of the conceptualization or articulating programs is accomplished, more information can be stored in long-term memory for immediate recall, or even longer-term retention of semantic information.

The opportunity for rehearsal or other control processes in short-term memory is restricted in the case of auding due to the nature of the speech display. For instance, in auding a lecture, in person or recorded on tape, the auder must aud at the pace set by the speaker. If this pace is rapid, little time for rehearsal is available. Also, if there is no opportunity for questioning or for having messages repeated, there is less chance that unfamiliar material can be assimilated into prior knowledge structures.

Thus, the transient nature and lack of referability of the spoken display in many auding situations (such as lectures, tests of "listening", and radio or television broadcasts) may stress the information-processing capabilities of the short-term memory control system, and produce less than maximal information storage by the auder. These factors are factors affecting the listening process, and hence the auding process. They may be overcome by improving the *referability* of the display: by permitting the asking of questions as a lecture progresses; by letting students ask for repeats of questions during testing—or better yet, by providing students with individual tape play-back machines and letting them present the information at an acceptable pace, and with as much replaying as needed, to listen to the message satisfactorily.

However, if a person lacks languaging skill (e.g., is unable to decode the English speech into articulating programs, and then derive conceptualizations therefrom), as an English-as-a-second-language student would, or lacks vocabulary and/or skill in conceptualizing, as a marginally literate adult would, then improving the referability of the display is not likely to suffice. In these cases, auding, not listening, is the major problem. The remedy for such problems is not as easy as that for overcoming the referability (listening) problem. Rather, long periods of training will probably be required to build requisite languaging and conceptualizing capabilities. For this reason, it is important that so-called "listening" tests be constructed and administered to identify major difficulties as listening or auding problems, or, if interactions occur, what factors are predominant in the interactions.

AUDING AS A TRACKING TASK

In various studies of selective listening (e.g., Morey, 1969), auding has been studied as a tracking task—the ability to follow a "moving" spoken message embedded within distracting noises, including situations in which two or more spoken messages may compete for attention. The research questions have focused upon the identification of the structured information or features which the auder may use to follow along with, attend to, or track the target message of the task. In Figure 3 we have outlined the more important features of a spoken message which research indicates an auder may use in tracking a message. We have sorted these features into acoustic, linguistic, and semantic categories.

Level

I. Acoustic Features
  Spatial Localization
  Voice Quality
  Speech Intensity

II. Linguistic Features
  Phonetic Constituents
  Syntax

III. Semantic Features
  Meaning of Message

Fig. 3. **Features a listener may use to track a spoken message.**

Regarding Acoustic Features, three dimensions are considered as significant factors with respect to aural message tracking: (a) spatial localization, (b) voice quality, and (c) intensity. Investigations using dichotically presented messages and shadowing tasks (Cherry, 1953; Treisman, 1960, 1964a, 1964b) have demonstrated that the structured information in the environment produced by having two ears (which produces the possibility of a sort of "triangulation" ability to localize objects in space), is a major dimension that allows for the tracking of a single message embedded in a noisy surrounding. Similarly, evidence has indicated (Cherry, 1953; Egan, Carterette, and Thwing, 1954; Talhurst and Peters, 1956; Triesman, 1964a, 1964b) that both voice quality features (i.e., the acoustic spectrum in voices) and message intensity can serve as information for aural tracking. Both features exhibit a facilitory effect on the ability to selectively track dichotic messages (i.e., competing messages presented one to each ear).

The chief source of evidence in support of the view that messages can be discriminated on the basis of linguistic features is derived from studies which manipulated the phonetic similarity between two competing messages. For example, Treisman (1964a) reported that when the irrelevant message was presented in an unfamiliar foreign language, rejection of this message was significantly easier than when the irrelevant message was composed of gibberish phonetically similar to English. Moreover, Miller and Isard (1963) supported the concept of linguistic feature analysis by revealing that syntax functions as a discriminable feature in auding.

Morey (1969) suggested a two-process theory of tracking—first the target message must be identified, then it must be followed. This ability to follow the target message through time typically implies that the auder attends to the semantic features of the message. In other words, given the presentation of messages similar in acoustic and linguistic features, the auder may rely upon semantic meaning to track (Sticht, 1972). Experimental evidence has tended to verify this view; Miller and Isard (1963) and Rosenberg and Jarvella (1969) found that subjects selected and devoted their tracking time to semantically meaningful or well-integrated messages—rather than to less meaningful messages.

This feature division (acoustic, linguistic, and semantic) parallels, at least roughly, our distinction of processes in auding. That is, the tracking of acoustic features can be construed as a "listening" issue, because these features of the acoustic display are involved in any listening task. Linguistic features, on the other hand, can be considered as a "language" issue; such features are appropriate to the selection and sequencing of a system of conventionalized signs. Finally, the semantic features of tracking imply "conceptualizing," or the extraction of meaning from the speech message.

We consider that, ordinarily, in auding continuous prose such as a lecture or recorded or broadcast presentations, the processing of acoustic and linguistic information is done automatically by preattentive processes. Automaticity cannot extend, however, to conceptualizing (La Berge and Samuels, 1973). The latter demands focal attention, and is hence subject to the constraints imposed by the operating parameters of focal attention specified by Blumenthal (1972) and stated earlier. Chapter V, Hypothesis 3 considers languaging and conceptualizing processes as factors that limit the rate of auding. It should be kept in mind that rate of focal attending may limit the rate at which conceptualizations can be formed, and hence limit auding performance, as well as reading performance, the topic to be discussed next.

READING AS LOOKING

In Chapter II we defined reading as "looking at script in order to language." In this section we will elaborate upon reading as a special kind of looking activity.

One factor characterizing reading as a special form of looking is that of the course of eye movements. The reader must learn to make short, successive fixations in reading. Furthermore, he is required to program the eye movements into a specific fixation order (i.e., in English, progressing from left to right in a descending fashion). This represents an unaccustomed task for the visual-motor system; it must be specifically conditioned to function in such a unique manner.

In looking, attention is given to the information in visual SIS and merged with information from long-term memory to produce a recognition or other type of comprehension response. However, as pointed out earlier, the attention process includes both a focus and a margin of attention. The visual information in SIS consists of information picked up by both the fovea and the periphery of the eye. The foveal information forms the information in SIS processed by focal attention, while the peripheral information makes up the margin of attention.

A substantial body of research (e.g., Hubel and Wiesel, 1965; Johnson, 1965, Gould, 1967; Mackworth and Morandi, 1967; Yarbus, 1967; Hochberg, 1970a; Hochberg and Brooks, 1970) has demonstrated that the peripheral retinal information may be used to enable the looker to differentiate between useful and useless information, it may function in the preattentive processing and editing of redundant stimuli, and it may indicate the locus of the next fixation. (i.e., it may serve to direct ballistic eye movements whose termination points are predetermined prior to their onset).

Beginning readers do not effectively utilize peripheral information, that is, they do not selectively extract visual field information from the peripheral portion of the retina. In contrast to the beginning reader, the accomplished reader has learned to use the peripheral retina to provide crucial information as to the direction and place of subsequent eye fixations. That is, he employs the periphery to furnish guidance for the ensuing course of eye movement. Hochberg (1970a) has referred to this process as *peripheral search guidance*.

Looking in reading, like any other form of looking, also involves the processing of information in visual SIS by focal attention. In turn, the latter process must satisfy some cognitive demand. Thus the cognitive goal directs focal attention, a process Hochberg (1970a) has referred to as *cognitive search guidance* in reading. During the early stages of reading, considerable focal attention must be given to learning the key features that permit the child to discriminate letters or whole words. The direction of focal attention to such features is particularly noticeable in children who learn to read before school, as indicated by an analysis of sequences of looking and cognitive direction exhibited by "early-readers."

Durkin's (1966) study of children who learned to read early indicated that more than half showed an interest in printing prior to reading. For these children, the learning sequence moved from (a) scribbling and drawing, to (b) copying objects and letters of the alphabet, to (c) questions about spelling, to (d) ability to read. In terms of the present model, (a) is *marking*, which has the effect of producing a structured light display that can then be scanned in visual SIS; (b) is marking which involves the external representation of information in visual SIS in terms of structured light to produce a match between the form being copied and the copy. This type of activity stresses the analysis of features of forms to make sure they match, and (c) implies the recognition of words, and the understanding that words are composed of letter elements, again evidence for the focus of attention on letters (in both spoken and visual form).

An important factor with Durkin's early readers is that their looking was guided by self-imposed cognitive task demands. That is, they directed their focal attention in accord with a cognitive goal. Presumably, they looked at their markings to see whether they were having an effect (children who are permitted to make marking movements that do not leave a trace soon lose interest, E. Gibson, 1969, p. 446); they looked at letters and words to produce and check their copy; they looked at words after having spelled them to satisfy a cognitive question (what does some spoken word look like?).

It seems likely that many children who are being taught to read may not know what they are to look for and focus upon, and may therefore have difficulty in learning to read. "Knowing" what to look for means that the child can formulate some internal goal and method for checking to see when the goal has been reached. For instance, suppose the teacher says, "Look at the word 'CAT' on the blackboard." The child must aud the message, comprehend what a word is (some primary school children apparently do not, Holden and MacGinitie, 1972), understand that the utterance "CAT" is a word in the spoken language, direct the gaze to the blackboard, visually examine the printed configuration and somehow understand that all three letters—not just "C" and "T" or "C" and "A"—are important elements of the graphic display of the spoken word "CAT".

The foregoing is quite different from the child's ordinary looking which is subservient to the child's self-imposed cognitive task. The teacher-imposed task may completely bewilder the child, making looking an almost pointless activity. This may be especially important if the teacher at one time expects the child to focus on whole words (patterns of visual features making up a word-shape) and at other times on elements of words such as letters, digraphs, inflectional morphemes, and other word segments. A type of looking "confusion" could result, in that the child would not precisely know where to direct his focal attention.

Different types of looking (achieved through differences in the directing of attention) partially account for distinctions between skimming, scanning, and reading. In skimming, the individual extracts information in a saltatory manner through a sequential series of focal fixations; that is, he focally attends to a unit of information, "skips" another unit, fixates, "skips" again, and so on. Information extracted through scanning is done so primarily by preattentive processing. The individual does not successively fixate his attention; rather, he uses the margin of attention to search the display in a manner more continuous than that of skimming. A combination of focal and marginal attention constitutes the processing of information through reading, which involves (a) in beginning reading, directing focal attention to relevant features of the graphic visual display in response to cognitive goals set by others (instruction) so that graphic word recognition skills may be learned, and (b) in more advanced reading, directing visual focal attention to strings of words as units within a single eye fixation, and using peripheral retinal information in the margin of attention to preattentively guide successive eye movements across the lines of print.

READING AS LANGUAGING

The principal factor that distinguishes reading from other looking activities is the languaging process. Reading involves the comprehension of conceptualizations represented in the form of graphic signs (markings which structure light) that have no necessary relationship to the conceptualization they represent—the graphic signs do not "look like" the ideas being communicated. Unlike photographs, realistic paintings, drawings, caricatures, or stick figures, the letters of the alphabet, graphic forms of words, and other components of the writing (graphological) system do not resemble any of the objects or events (real or imagined) they are meant to represent. Rather, like the spoken language upon which it is based, the printed language is a highly encoded representation of human thought (conceptualizations). Thus, unlike forms of looking in which structured optical information formed by objects or the pictographic likeness of objects is represented and stored in visual SIS for direct processing by focal attention (in STM) for use in conceptualizing, looking-as-reading involves a decoding stage, in which the printed symbols are converted into language signs, which can then be used in conceptualizing.

As in auding, then, the reader must attend to an environmental display and convert it into an internal language display which can then be used in conceptualizing. According to the present model, the internal language used in reading is the oral language used in speaking and auding. By this we mean that the signs and rules for sequencing these signs (syntax) used in auding are also used in reading. In learning to read, the child must learn that printed words stand for spoken words. Now, since spoken words are composed of programs of articulatory movements (p. 51), for the child to recognize that the printed word corresponds to the spoken word means that he must associate a printed display with the internal articulatory program that controls the production of the word aloud.

As we have seen, Durkin's (1966) children who learned to read "naturally" (primarily in an untutored setting prior to formal schooling) somehow came to realize that speech is made up of words, printed words "stand for" those words, and the printed words are made up of letter elements.[1]

It is important to note that those early-reading children did not attempt to use words to "directly" express some conceptualization, nor did they associate printed words directly with some conceptualization while failing to associate the printed with the spoken word. Rather, they conceived of the printed word as an alternative form of the spoken word—in other words, conceptually, for these children print was conceived as *speech written down.*

The foregoing is important because it bears on a fundamental problem in reading, the problem of teaching children to read. In a recent book, deliberately characterized by the author as polemical (p. vi), it is argued that print is not speech written down, and that children do not, indeed cannot, learn to read by decoding print to speech (Smith, 1973). The controversial nature of this assertion is indicated by the statement of a leading researcher in reading that the decoding aspect of reading can be considered as learning to "read out in units of the spoken language what is directed by the graphic units" (E. Gibson, 1969, p. 434). Also, Carroll (1971) states that "Essentially, the reading process is one of using printed or written symbols and sequences of symbols as cues to construct some kind of representation of a spoken message" (p. 133).

Smith's position seems to be based largely on a very broad and loose definition of reading as practiced by skilled readers. For instance, he permits "fluent" readers to make many "errors" at the "word" level so long as "meaning" is retained. He states, "If you are reading so that listeners can comprehend you, it is far more important that you comprehend yourself what you are reading than that you identify every word correctly" (p. 79). It is, of course, a truism that we frequently make such "errors", but simply because a plausible meaning is maintained does not mean that the meaning intended by the writer was maintained. Clearly, this approach makes reading one-sided, it neglects the fact that reading is a communication activity, and that, from the writer's point of view, a mis-reading is an "error", the exact meaning is not preserved, although what change occurs may not be too important to either the writer or the reader.

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[1] We note that these children did not necessarily associate a speech *sound* with a letter; rather, they learned spoken names for the printed letters so they could spell (print) a graphic representation of a word in their oral language.

Smith also asserts that "Individual words do not carry any information about how they should be articulated" (p. 77). But then he points out that even such words as permit (PERmit or perMIT) or read (red or reed) can be read in "list intonation." What he means, of course, is that we need context to know how to pronounce these words in sentences. But clearly they give some information about how they should be articulated even in a list. Furthermore, as we saw in Durkin's study, children who learn to read on their own first read words, not sentences—so do children who are taught to read.

It is also clear to those who can read this display aloud, "Umgogly vaped um callinger, yardidly zingored pey," that meaning is not required to produce a spoken sentence. Rather, an understanding of the correspondences between printed words and the articulatory programs of the oral language (signs and syntax) permits the utterance of the sentence with no conceptualizing (meaning) necessary. Hence, Smith's contention that "Before you can utter a sentence, you must know what it means" (p. 77) is clearly not true. A more accurate statement is that in order to make a proper articulation of some of the words in some sentences, it is necessary to have developed some understanding of the underlying conceptualization represented by the sentence or parts of the sentence.

One final point raised in Smith's polemic deserves some comment. In a section which intends to demonstrate that a skilled reader could not first identify words and then comprehend what he is reading, and that comprehension must precede identification, he states that "Although visual information sufficient for the identification of four words may be available in a single fixation, and four fixations a second may be made, the skilled reader cannot identify words (that is, read material aloud) at the rate of 16 words per second (almost 1000 words a minute) but instead at barely a quarter that rate (a limit which is not set by the rate at which words can be articulated)." (pp. 63-64)

What Smith fails to point out is that, (a) although the eye typically may make four fixations per second, the visual information included in each successive fixation is not new but rather has considerable overlapping, hence word identification may still be going on for the information in the overlapping segments of the visual field; and (b) it turns out (see Chapter V, Hypothesis 3) that the rate of reading continuous prose aloud may, indeed, be limited by the rate at which words can be articulated aloud, to about four or five words per second, or 240 to 300 words per minute. But these rates are comparable to the silent reading rates of better readers (college students), and, since such rates of articulation are possible (even aloud, with muscle inertia and lag time between internal articulatory processing and actual movements), it is then completely possible for visual words to be decoded by reference to internal articulatory programs at rates quite compatible with typical (and Smith, p. 64, agrees, even optimal) rates of proficient reading.

We find ourselves, then, in disagreement with many of Smith's assertions, and in agreement with Carroll's (1971) position that the printed display is converted to an internal representation of a spoken message, which is then used in conceptualization as discussed in Chapter III. In the early stages of learning to read, it seems likely that the child will attempt to decode such units of print into units of the spoken language as are involved in the teaching process. Thus, a teacher who uses a whole-word approach will stimulate children to decode entire printed words into spoken words (i.e., the unit of decoding will be the word). A teacher who uses a strong phonics approach will stimulate the use of letters and letter clusters to decode printed word segments into spoken word segments.

Regardless of the unit(s) used in decoding, children must practice decoding until the process becomes automatic. This *automaticity* (Samuels and Dahl, 1973) level of skill in decoding implies more than simple accuracy in word recognition; additionally, it refers to a behavior that can be performed without attention. During the early stages of learning to read, considerable focal attention is given to decoding considerations. As long as the reader attends to *decoding*, he will be unable to adequately *comprehend* the message—for the processing of information into meaning also requires this focusing of the single channel capacity of focal attention.

When the reader has practiced beyond simple accuracy in word recognition, and has reached the stage where decoding occurs automatically without the services of focal attention, automaticity has been achieved. Attention can subsequently be directed toward the processing of meaning (conceptualizing) from the printed display. Whereas initially a child needs to scan the visual display, make visual discriminations, decode the print into articulatory programs, and finally conceptualize (focally attending to each successive step), with practice the reader learns to scan the visual display in the margin of attention, while focal attention is given to conceptualizing its content. Decoding is done preattentively (automatically) and, instead of a series of graphemes, or printed words, a concept is perceived.

Presumably what happens at the automaticity stage of development of reading skill is that, for instance, the eyes first fall on the left-hand side of the printed page at the start of the first sentence and store the visual information in the fixation in SIS. Next, while this information is being processed into internal articulatory programs, and then into conceptualizations in focal attention, the preattentive processes direct the eyes to the next fixation point, and the processing continues. By this approach, the eyes would stay ahead of the conceptualizing—but focal attention and hence our subjective experience would be at the conceptualizing stage. Phenomenologically, then, we would "directly" perceive the meaning in the printed message, just as we "directly" perceive the meaning of spoken messages.

Carroll (1971) states that ". . . once the printed or written message is transformed into a representation of a spoken message, it becomes an object to be comprehended just as a spoken message is an object to be comprehended" (p. 133). In the present context, this means that, once reading decoding skills have been acquired and developed to the point of automaticity, reading is primarily a matter of languaging and conceptualizing. For this reason we expect that, even though children and adults may acquire considerable decoding skill, they will not necessarily perform well on a variety of reading tasks because of the language and conceptualizing demands of the tasks. It is a mistake, then, to believe that ". . . the 'reading problem' as we know it would not exist if, in dealing with language, all children could do as well by eye as they do by ear" (Kavanagh and Mattingly, 1972, p. 1). The fact of the matter seems to be that the great majority of school children do learn to language as well by reading as they do by auding—but large numbers of them cannot do too well by auding.

For instance, Sticht *et al.* (1972) found that 22% of men who entered the U.S. Army with mental aptitude scores between the 20th and 30th percentiles on the Armed Forces Qualification Test read below the sixth grade level, and hence may have suffered from some lack of decoding skill (see Chapter V, Hypothesis 1 for a discussion of "mature" reading in relation to school grade). However, some 50% read between the 6th and 10th grade levels. These levels of achievement seem to rule out major decoding problems and suggest, instead, that these men lack the broad range of vocabulary and conceptual knowledge required to perform at the 12th grade level or higher, even though most of them were high school graduates. In other research, Sticht (1968) found that a group of lower mental aptitude men were no better at comprehending messages presented in spoken form than they were in comprehending the same messages by reading.

The National Assessment of Educational Progress, Reading Survey report indicates that a national sample of 17-year-olds and young adults performed quite well on reading tasks involving using visual aids (graphs, maps), following written directions, using reference materials, and getting significant facts from printed sources. However, tasks involving vocabulary knowledge, reading for main ideas, drawing inferences, and critical reading were poorly performed—especially by people from family backgrounds where the parents had no high school education. In these cases, less than 60% of the 17-year-olds correctly performed the latter set of reading tasks, while less than 65% of the young adults satisfactorily performed these reading tasks. Drawing inferences was the most difficult of all tasks.

These data suggest that most people in our society learn to read/decode reasonably well—it is lack of languaging and conceptualizing which are the major factors in "functional" illiteracy; that is, the inability to perform a given set of reading tasks. Therefore, even if people could "do as well by eye as they do by ear" in dealing with language, the major reading problems would not be solved, because many people cannot comprehend well by ear—that is, both auding and reading competencies are underdeveloped. For comments regarding the improvement of these competencies, see Chapter V, Hypothesis 4.

AUDING AND READING COMPARED

Auding and reading are considered to be similar processes because both require the use of language and languaging, and because, with identical messages, both result in the formation of a single, mutual internal conceptualization.

Given that a languaging component is common to auding and reading, characteristics of languaging must share in both of these receptive processes. One of these characteristics is that of the sequential processing of information. In languaging, units of information are processed on a serial basis, or one after another rather than simultaneously. Because of memory factors involved in this activity, current processing is affected by previous processing. Even though strategies (e.g., chunking) which lead to the development of the parallel processing of message portions may evolve, the entire message must be sequentially processed. Moreover, the speech and print displays themselves, by the method in which they present information, necessitate this serial processing.

Another common auding/reading languaging factor pertains to the redundancy of information contained within both the auding and the reading message. That is, both messages consist of elements and processes that provide for predictability. For example, spelling patterns, grammatical structure, and syntactical rules exhibit certain regularities and entail certain invariants which suggest what will follow. They render some indication as to the immediate progression of the message, and permit the auder/reader to anticipate what is coming next, improving the efficiency of information processing.

The principal differences between auding and reading originate through the nature of the display from which information is extracted. It is the different qualities of the display which produce the major task variables distinguishing auding from reading. For example, the speech message display is characterized by a temporally linear, transient message which occurs at a presentation rate determined by the source rather than the auder. Even though, in face-to-face situations, the auder can exert an influence upon the nature and rate of message production by the speaker, he is not in direct control over it. Conversely, the printed display is characterized by an existent, virtually permanent message which can be scanned in a pattern and at a rate determined by the reader. He can directly control the scanning process through the development of specific searching strategies.

This durable display is partially responsible for the result that printed messages are sometimes more conducive to comprehension than speech messages. The persistence of the printed message permits the reader to either scan ahead for predictive information, or backward in a regressive manner, for repetition of the message. In a word, the reading display is "referable," that is, by its nature it allows the reader to reread the message—therefore facilitating comprehension. It is not the mere physical presence of the printed message, or any advantage associated with the visual modality, that accounts for the sometimes superior comprehension of difficult material through reading; rather it is the fact that reading easily permits preview, review, and study of the message as a function of its permanency.

Other display considerations that distinguish auding from reading pertain to the respective suprasegmental and orthographical aspects of speech and print. Suprasegmental factors such as intonation and rhythm are typically contained within the speech display, but do not exist within the printed display. It is granted that certain punctuational symbols and grammatical techniques are utilized in writing to approximate these qualities, but they generally cannot properly convey the intended verbal message.

In regard to orthography, the written representation of a word occasionally imparts more information than that of a spoken word. For example, when a reader sees the individual words (homophones) site, sight, or cite presented in print, the spelling differences facilitate conceptualization. In auding, however, the meaning of homophones must be derived solely from contextual information. That is, the auder requires additional information in order to properly conceptualize homophones in the auditory message.

In the case of homophones, then, the graphic display contributes information not available in the acoustic display, while in the latter, suprasegmentals contribute information not available in the graphic display. Interestingly, however, most tests of reading and auding ability do not emphasize these differences in the auding and reading languages. Rather, they generally focus on the information commonly available in both language displays.

In this regard, since auding and reading seem to lead to common comprehension points, it appears that it should be possible to construct auding and reading test batteries which would be useful in indicating discrepancies between these skills, and for estimating how much improvement in reading might be expected in a literacy training program. It would also be possible to measure a person's ability to comprehend language by auding (without imposing on him the reading decoding task) and then, having discovered his auding language level, to determine whether he is reading below his auding level and, if he is, how far below. The first goal of literacy training might then be to train the person to comprehend by reading what he can comprehend by auding.

Finally, an additional factor which serves to distinguish auding and reading pertains to the function of peripheral vision. In reading, much structured information is derived from the peripheral field and processed preattentively. This peripheral information provides advance knowledge about the message, while serving to direct the course of the subsequent eye movement. Obviously, no such information is obtainable from the speech message. Through the use of contextual and linguistic information, however, some expectations can be formulated in regard to speech; yet this information is not actually available in the display for preattentive processing.

By way of summary, we see that auding shares many of the same characteristics as reading, beginning with the prerequisites of attention and memory. Beyond that, both require the acquisition of language—of understanding the system for selecting and sequencing conventionalized signs. Furthermore, it is necessary that these signs be decoded and processed into conceptualizations. That is, auding and reading both imply the recognition and conversion of symbolization into meaningful cognitive content. In addition, both skills rely upon the ability to form discriminations between stimuli (either visual or auditory), and depend on the development of higher order strategies (e.g., chunking) for subsequent improvement. To state it concisely, auding and reading differ primarily in the manner in which the individual receives the stimulus words; they are similar in the sense that they are both receptive communication acts that require a central language and conceptualizing base.

Chapter V

A REVIEW OF LITERATURE RELATED TO FOUR HYPOTHESES DERIVED FROM THE MODEL

Earlier we indicated that the value of another literature review in this area rests on the development of an organizing scheme which permits more than the classification of studies into pigeon-holes, or which is developed *post hoc* as a consequence of a more or less non-theory-directed search of the literature. Quoting Gephart (cited by Geyer, 1971), it was pointed out that what is desired is a model of the development of reading which, among other things, provides the basis for deriving testable hypotheses regarding relationships among the components of the model. When a model permits this type of testing, it is possible to validate (or invalidate) it, and thus to move toward a better understanding of the phenomena encompassed by the model.

In this chapter, we will test the validity of aspects of the developmental model described earlier, by reviewing literature bearing on four hypotheses derived from the model. They arise primarily from two strong assertions in the model about *competencies*, both limited to "the typical case": (a) competence in languaging by auding precedes competency in languaging by reading; (b) *when acquired*, reading utilizes the same cognitive content and languaging competencies that are used in auding, plus the competencies involved in searching the visual display and, at least initially, decoding print to speech.

From these assertions about *competency*, we derive four hypotheses about *performance*:

1. Performance on measures of ability to comprehend language by auding will surpass performance on measures of ability to comprehend language by reading during the early years of schooling until the reading skill is learned, at which time ability to comprehend by auding and reading will become equal.

2. Performance on measures of ability to comprehend language by auding will be predictive of performance on measures of ability to comprehend language by reading *after* the decoding skills of reading have been mastered.

3. Performance on measures of rate of auding and rate of reading will show comparable maximal rates of languaging and conceptualizing for both processes, assuming fully developed reading decoding skills.

4. Training in comprehending by auding of a particular genre (e.g., "listening for the main idea") will transfer to reading when that skill is acquired. Conversely, once reading skill is acquired, new cognitive content learned by reading will be accessible by auding. Again, this reflects the model's position that reading and auding simply represent alternative in-roads to shared languaging competencies and cognitive content. Thus, additions to this content become equally accessible by auding and reading, once the latter is acquired.

A hindrance to a comprehensive review of literature bearing on any one of these hypotheses is the large number of unpublished theses and dissertations of relevance, and the fact that many libraries will not provide inter-library loans of these materials. Since we could not obtain some studies, this review cannot be considered exhaustive.

HYPOTHESIS 1

In this section we will summarize literature bearing on the first of the four hypotheses. The literature reviewed is restricted to studies using somewhat "molar" measures of auding and reading vocabulary and comprehension competencies. By "molar", we mean that the measures used do not permit the detailed analysis found in information-processing studies involving measures such as reaction time differences between auding and reading of words and the like. Rather, the measures included in the reviewed studies are the vocabulary and paragraph comprehension measures typically found in standardized and experimental tests of auding ("listening") and reading.

Some 44 studies were found that appeared relevant to Hypothesis 1, that is, auding performance will exceed reading performance in the early years of schooling and later become equal. Of these 44 studies, 31 were obtained and reviewed with regard to the following: (a) grade level of the students tested; (b) whether or not the same, matched, or independent students were tested under both auding and reading conditions; (c) whether or not the same, equivalent, or just different content materials were used under both auding and reading conditions; (d) whether or not auding and reading conditions were counterbalanced in order of presentation; (e) whether or not reading and auding rate had been equated by matching auding and reading rate; (f) whether or not time for auding and reading had been equated by limiting reading time to the time required to aud the passage; (g) whether or not students were instructed to read the passage through once, taking the amount of time needed, regardless of whether or not this exceeded the auding time; (h) whether the results showed auding performance to be greater than reading performance ($A > R$), equal to reading performance ($A = R$), or less than reading performance ($A > R$). The results of the review are summarized in Tables 2 and 3.

The columns of these tables present the information listed in (a) through (d), in the same order. Blank cells in the table mean that the information was either not presented or was unclear to both reviewers in the description of the study. Minus signs (-) indicate that the condition did not hold for that study, while the check (✓) indicates that the condition did hold.

Table 2 presents studies using vocabulary measures, while Table 3 presents studies using comprehension measures. In one study (Miller, 1941) vocabulary and comprehension measures were obtained from the same students tested at the same sitting. However, since separate analyses of vocabulary and comprehension data were made, we have reported these as separate comparisons of auding and reading performance. Where a study reported results of testing students at two or more grade levels, we recorded results by grade levels and hence the same study is cited across several grade levels. If a study reported separate analyses for different groups within a grade level, such as high ability and low ability students, we have reported these comparisons separately. Thus Tables 2 and 3 summarize 71 comparisons of auding versus reading performance from 31 research reports spanning first-grade to college students and out-of-school (mostly young) adults.

Most studies showed a fair level of design sophistication. For instance, where identical students and identical or "equivalent" materials were used, the order of

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Table 2

Summary of Research Comparing Auding and Reading Vocabulary

	Controls Used							
Grade Level	Subjects	Materials	Presentation Order	Auding and Reading Rate Matched	Reading Time Matched to Auding Time	Reading Time Unspecified	Results	Reference
1	Identical	Identical	Read first				A > R	Armstrong, H.C. 1953
2	Identical	Identical	Read first				A > R	Armstrong, H.C. 1953
	Identical	Identical	Aud first				A > R	Hauser, M.H. 1963
3	Identical	Identical	Read first				A > R	Armstrong, H.C. 1953
	Identical	Identical	Aud first				A > R	Hauser, M.H. 1963
	Identical	Identical	Counterbalanced				A > R	Miller, E.A. 1941
	Identical	Identical	Counterbalanced				A > R	Yates, P.S. 1937
4	Identical	Identical	Read first				A > R	Armstrong, H.C. 1953
	Identical	Identical	Counterbalanced				A > R	Miller, E.A. 1941
	Identical	Identical	Counterbalanced				A > R	Yates, P.S. 1937
5	Identical	Identical	Read first				A > R	Armstrong, H.C. 1953
	Identical	Identical	Counterbalanced				A = R	Yates, P.S. 1937
6	Identical	Identical	Read first				A > R	Armstrong, H.C. 1953
	Identical	Identical	Counterbalanced				A = R	Yates, P.S. 1937
7	Identical	Identical	Read first				A > R	Armstrong, H.C. 1953
12	Identical	Equivalent				✓	R > A	Burton, M. 1943

(Continued)

Table 2 *(Continued)*

Summary of Research Comparing Auding and Reading Vocabulary

Grade Level	Controls Used						Results	Reference
	Subjects	Materials	Presentation Order	Auding and Reading Rate Matched	Reading Time Matched to Auding Time	Reading Time Unspecified		
College								
Low Reading Ability Subjects	Identical	Equivalent					A > R	Anderson, J.H. and Fairbanks, G. 1937
Median Reading Ability Subjects	Identical	Equivalent					R > A	Anderson, J.H. and Fairbanks, G. 1937
High Reading Ability Subjects	Identical	Equivalent					R > A	Anderson, J.H. and Fairbanks, G. 1937
	Identical	Equivalent		--	--	✓	A = R	Schubert, D.G. 1953

Table 3

Summary of Research Comparing Auding and Reading Comprehension

Grade Level of Subjects	Controls Used						Results	Reference
	Subjects	Materials	Presentation Order	Auding and Reading Rate Matched	Reading Time Matched to Auding Time	Reading Time Unspecified		
3	Identical	Identical	Counter-balanced				A > R	Erickson, C.I. and King, I. 1917
	Identical	Identical	Counter-balanced				A > R	Miller, E.A. 1941
4							A > R	Brassard, M.B. 1970
	Identical	Identical	Counter-balanced				A = R	Emslie, E.A., et al. 1954
	Identical	Identical	Counter-balanced				A > R	Erickson, C.I. and King, I. 1917
	Matched	Identical	N/A		✓	--	A > R	Hampleman, R.S. 1958

(Continued)

Table 3 *(Continued)*

Summary of Research Comparing Auding and Reading Comprehension

Grade Level of Subjects	Controls Used						Results	Reference
	Subjects	Materials	Presentation Order	Auding and Reading Rate Matched	Reading Time Matched to Auding Time	Reading Time Unspecified		
4 *(Cont.)*	Identical	Identical	Counter-balanced				A > R	Hanna, R.C. and Liberati, M. 1952
	Identical	Identical	Counter-balanced				A > R	Joney, O.L. 1956
	Identical	Identical	Counter balanced				A = R	Miller, E.A. 1941
	Identical	Equivalent	Counter-balanced	--	--	✓	A > R	Young, W.E. 1930
	Identical	Equivalent	Counter-balanced	--	✓	--	A > R	Young, W.E. 1930
5							A > R	Brassard, M.B. 1970
Measure of "Total Meaning"	Matched	Identical	N/A				A > R	England, D.W. 1952
Measure of "Retention of Details"	Matched	Identical	N/A				A = R	England, D.W. 1952
	Identical	Identical	Counter-balanced				A > R	Erickson, C.I. and King, I. 1917
	Matched	Identical	N/A	--	--	✓	A > R	Friedman, R.M. 1959
	Matched	Identical	N/A	--	✓	--	A > R	Russell, R.D. 1923
	Matched	Identical	N/A	--	--	✓	A > R	Russell, R.D. 1923
	Identical	Equivalent	Counter-balanced	--	--	✓	A > R	Young, W.E. 1930
	Identical	Equivalent	Counter-balanced	--	✓	--	A = R	Young, W.E. 1930
6							A > R	Brassard, M.B. 1970
	Identical	Identical	Counter-balanced				A > R	Erickson, C.I. and King, I. 1917

(Continued)

Table 3 *(Continued)*

Summary of Research Comparing Auding and Reading Comprehension

Grade Level of Subjects	Controls Used							
	Subjects	Materials	Presentation Order	Auding and Reading Rate Matched	Reading Time Matched to Auding Time	Reading Time Unspecified	Results	Reference
6 *(Cont.)*	Matched	Identical	N/A	--	✓	--	A > R	Hampleman, R.S. 1958
	Identical	Identical	Counter-balanced				A > R	Kelly, E.V., *et al.* 1952
Boys	Identical	Identical	Counter-balanced	--	✓	--	A > R	King, W.H. 1959
Girls	Identical	Identical	Counter-balanced	--	✓	--	A = R	King, W.H. 1959
	Identical	Equivalent	Counter-balanced	--	--	✓	A = R	Young, W.E. 1930
	Identical	Equivalent	Counter-balanced	--	✓	--	A = R	Young, W.E. 1930
	Identical	Identical	Counter-balanced	--	✓	--	R > A	Many, O.A. 1965
7	Identical	Identical	Counter-balanced				A > R	Erickson, C.I. and King, I. 1917
	Identical	Identical	Counter-balanced				A = R	Kelly, E.V., *et al.* 1952
	Matched	Identical	N/A	--	✓	--	A = R	Russell, R.D. 1923
	Matched	Identical	N/A	--	--	✓	A = R	Russell, R.D. 1923
8	Identical	Identical	Counter-balanced				A > R	Erickson, C.I. and King, I. 1917
9	Identical	Identical	Counter-balanced				A > R	Erickson, C.I. and King, I. 1917
	Matched	Identical	N/A	--	✓	--	A = R	Russell, R.D. 1923
	Matched	Identical	N/A	--	--	✓	A = R	Russell, R.D. 1923
11	Identical	Identical	Counter-balanced	--	✓	--	R > A	Haugh, O.M. 1952

(Continued)

Table 3 *(Continued)*

Summary of Research Comparing Auding and Reading Comprehension

Grade Level of Subjects	Controls Used							
	Subjects	Materials	Presentation Order	Auding and Reading Rate Matched	Reading Time Matched to Auding Time	Reading Time Unspecified	Results	Reference
College								
	Identical	Equivalent	--	--	✓	--	R > A	Brown, J.I. 1948
Poorest Readers	Identical	Identical	Counterbalanced				A > R	Greene, E.B. 1934
Total Group Minus Poorest Readers	Identical	Identical	Counterbalanced				R > A	Greene, E.B. 1934
							R > A	Henneman, R.G. 1952
	Independent	Identical	N/A	--	✓	--	R > A	Jester, R.E. and Travers, R.M.W. 1966
	Independent	Identical	N/A	--	--	✓	A = R	King, D.J. 1968
	Identical	Equivalent	Counterbalanced	--	--	✓	R > A	Larsen, R.P. and Feder, D.D. 1940
	Independent	Identical	N/A	--	--	✓	A > R	Worcester, D.A. 1925
Adults Low Aptitude Men	Identical	Identical	Counterbalanced	--	✓	--	A = R	Sticht, T.G. 1968
Average Aptitude Men	Identical	Identical	Counterbalanced	--	✓	--	A = R	Sticht, T.G. 1968
				--	✓	--	R > A	Webb, W.B. and Wallon, E.J. 1956
				--	--	✓	A = R	Webb, W.B. and Wallon, E.J. 1956
	Identical	Identical	Counterbalanced	✓	--	--	A > R	Goldstein, H. 1940

presentation of the material for auding and reading was usually, although not always, counterbalanced. By "equivalent" materials we mean that the grade level or other index of difficulty, such as readability, was used to match materials presented for auding or reading. Armstrong's (1953) vocabulary study used a procedure in which students first received a printed word to read and define. If they could do the reading task it was assumed that they could have defined the word had they auded it, and hence it was counted as being in both auding and reading vocabulary. Words not read were presented in spoken form for auding and defining and counted in the auding vocabulary only.

None of the comparisons of Tables 2 and 3 matched auding and reading *rates* (Goldstein's (1940) work closely approximated this match), although a number of the comprehension studies limited reading time either to the time required to present the message in spoken form, or to the time required for students to read the material through once at their normal rates. In some comprehension studies effects of manipulation of the latter two controls were assessed (Young, 1930; Russell, 1923; Webb and Wallon, 1956), and these are recorded as separate comparisons in Table 3.

To bring the data of Tables 2 and 3 to bear on Hypothesis 1, Figure 4 is presented. This figure shows, for five grade levels, the proportions of comparisons for which auding performance exceeded reading performance (A > R), auding and reading performance was equivalent (A = R), and auding performance was inferior to reading performance (A < R). To construct the figure, we have counted vocabulary and comprehension studies together and grouped the comparisons as: grades 1, 2, 3 (N = 9); grade 4 (N = 12); grades 5, 6 (N = 22); grades 7, 8, 9, 11, 12 (N = 11); and college and adults (N = 17).

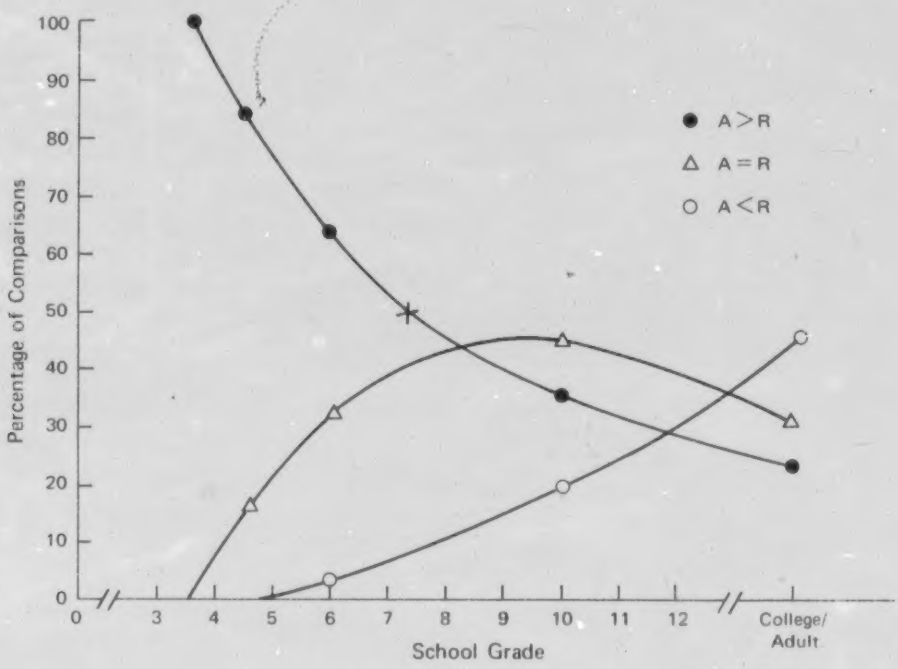

Fig. 4. **Comparison of auding and reading performance at five schooling levels.**

As indicated, all of the comparisons for the first three grades show $A > R$. This proportion drops as a negative function of grade level. As grade level increases, the proportion of comparisons in which $A = R$ grows, and becomes equal to the proportion of comparisons showing $A > R$ at around the eighth grade level. Reading excels only at the college and adult levels, where close to half of the comparisons show $A < R$.

The triangles in Figure 4 indicate the proportion of comparisons in which auding and reading performance is equal (not significantly different). Although limited data points restrict the certainty of this presentation, there appears to be an inverted-U relationship between grade level and the equivalence of auding and reading performance. This inversion reflects the increased numbers of comparisons at the college and adult level where reading surpasses auding performance (a point we will comment on later).

The data of Figure 4 suggest a method for defining what is meant by the elusive term "mature" reading—"mature" reading is the level at which reading competency equals auding competency. In Figure 4, the (+) on the auding curve marks the level of "mature" reading, that is, the point at which the probability of finding $A > R$ is equal to the probability of finding $A \overline{<} R$. The point is near the middle of the seventh grade level. Given the margin for error in these methods, it seems safe to assume that "mature" reading is achieved, in the typical case, sometime in the seventh or eighth grades. It is of interest to note that eye-movement research has indicated that the adult pattern of eye movements is achieved by the eighth grade (Tinker, 1965, pp. 81-84). If, following Tinker, it is considered that effective comprehension causes efficient eye movements, rather than eye movements causing comprehension, then the data of Figure 4 suggest that, because reading comprehension becomes equivalent to auding comprehension around the seventh or eighth grade, eye movement patterns reflect the "smooth" process of comprehension achieved by auding.

At the college and adult level, the proportion of comparisons in which reading clearly exceeds auding ($A < R$) is only .5, suggesting that some college students and adults never achieve superior efficiency in gathering information by looking at print in order to language.

It seems most likely that the increase in reading over auding performance found in about half the cases at the adult and college level represents improved skill in extracting information from the stable visual display of print, rather than indicating an ability to comprehend some material by print that cannot be comprehended by auding.[1] This is suggested by Goldstein's (1940) work, which is the only study found in which reading rate was paced line-by-line to match the speed of presentation of material for auding. With this control of reading rate, auding exceeded reading comprehension.

In general then, the data of Tables 2 and 3 and Figure 4 support the first hypothesis derived from the model: Auding performance exceeds reading performance during the early years of schooling. Furthermore, data of Figure 4 indicate that near the seventh and eighth grade levels, auding and reading performance are comparable, suggesting a definition of "mature" reading as the reading skill level at which reading competency equals auding competency (seventh or eighth grade reading ability, in the "typical" case).

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[1] Note that the superiority of auding over reading performance in the early years of schooling *does* indicate the ability to comprehend language by one mode and not the other, whereas the superiority of reading over auding at the adult level is interpreted as a quantitative (amount learned), not qualitative (what can be learned), modality difference. The model rules out the latter possibility.

HYPOTHESIS 2

Because reading is assumed to utilize the same languaging and conceptual base as is used in auding, we expect that, in general, persons who score high on measures of languaging by auding will also score high on measures of languaging by reading, once that skill is acquired. A similar expectation holds for persons scoring low on measures of auding—we expect them to score low on measures of reading.

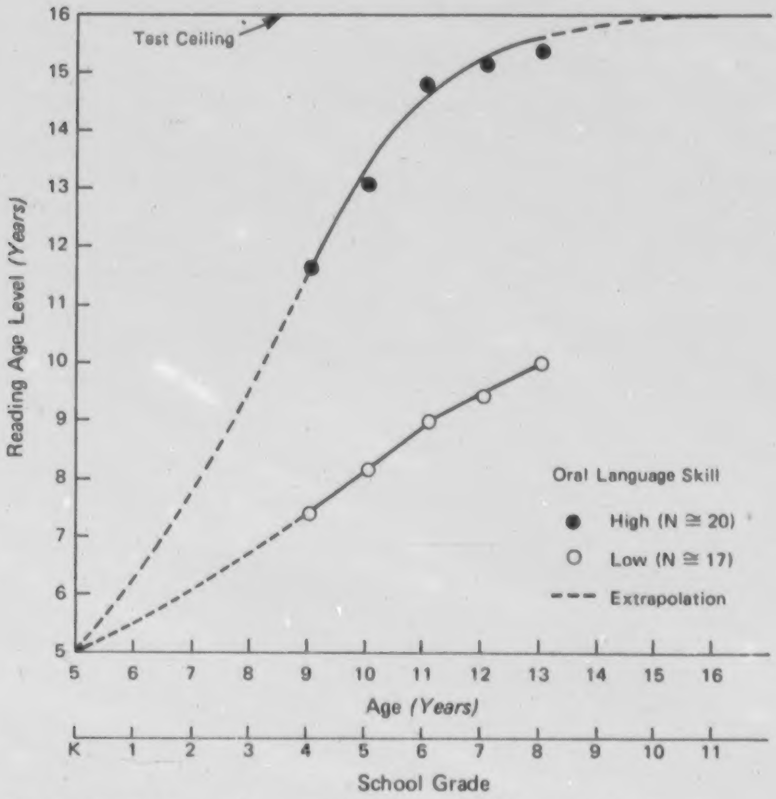
Thus, Hypothesis 2 states that performance on measures of ability to comprehend language by auding taken before reading is learned will be predictive of performance on measures of ability to comprehend language by reading after the decoding skills involved in reading have been acquired.

It is important to note that Hypothesis 2 is specifically addressed to relationships between auding and reading *comprehension* test performance. We are not concerned here with relationships between such things as auditory discrimination, phonemic segmentation, matching rhyming words, and the like, which are frequently measured in "reading readiness" tests, and achievement in learning to read at the end of the first grade. Rather, our interest is in relationships between comprehending thoughts by language through auding and comprehending thoughts by language through reading.

Ideally, what we would like to have found are studies in which children of kindergarten age were assessed with regard to auding ability, and then longitudinally followed to relate auding ability to reading ability. Because Hypothesis 2 predicts relationships between auding and reading *after* reading decoding skills are thoroughly learned, we would expect to find correlations between auding ability and reading ability fairly low in the early school grades, when children are a more homogeneous, nearly illiterate group. Then, as reading decoding skills are acquired, and the child is able to access more and more of his oral language competencies and hence his conceptual base via print, correlations between auding and reading should increase. Thus we would expect to find correlations low in the early, primary grades, with an increase in magnitude over the school years.

Unfortunately, no studies of such a nature have been found. The closest approximation to our "ideal" study is the longitudinal research of Loban (1961, 1963, 1964, 1967). He presents data on reading achievement in grades 4, 5, 6, 7, and 8 for children who were evaluated for oral language competency by means of a vocabulary test administered orally, and teachers' ratings on (a) amount of language, (b) quality of vocabulary, (c) skill in communication, (d) organization, purpose and control of language, (e) wealth of ideas, and (f) quality of listening. The Stanford and California Reading Achievement Tests were used to assess reading achievement.

Figure 5 presents data from Loban's (1964) research. The figure has been constructed from data presented in Table 16 (p. 117) of Loban's report, which gives median years and months for students in high and low oral language groups who scored above or below the norm for their age group. High language ability students were those who scored two standard deviations above the mean of the oral language ratings obtained in kindergarten; low language ability students scored two standard deviations below the mean. In constructing Figure 5, we have assumed that the data for fourth grade students are deviations above or below average for 9-year-olds, that is, students beginning grade 4; for 10-year-olds at grade 5; 11-year-olds at grade 6, and so forth. Actual age figures were not given in Loban's report—just deviations from age norms. Thus the data points of Figure 5 are only close approximations. For our purposes they are accurate enough, however, for they clearly



NOTE: Figure constructed from data given in Loban, 1964, page 117, Table 16.

Fig. 5. **Relationship between chronological age/school grade level and median reading ability for students rated high or low in oral language skills in kindergarten.**

point to a strong relationship between oral language ability in kindergarten, and subsequent reading ability, at least for extreme groups.

While Loban nowhere presents correlation coefficients for oral language and reading achievement for the total sample of students studied, he does present scatter diagrams for grades 4, 6, and 8. From these diagrams we have computed contingency coefficients—.36, .49, and .52 for grades 4, 6, and 8 respectively.[1] Thus, for the total group, as well as the extreme groups of Figure 5, there is a positive relationship between oral language and reading. Furthermore, the relationship grows with increases in grade level, which is consistent with the expectation that auding and reading test performance will be more highly correlated after the learning to read (decoding) phase.

[1] The use of a 2 x 2 contingency table restricts the upper limit of the correlation coefficient to +.71 (Siegel, 1956). Thus the contingency coefficients tend to underestimate the relationship between oral language and reading.

Additional data regarding relationships between auding and reading are presented in Table 4. There we have what can only be regarded as a limited, unsystematic sample of the many studies that report correlations among all manner of measures of auding and reading tests. Literally dozens of unpublished master's theses and doctoral dissertations which report such correlations can be found cited in various sources (Duker's 1968 bibliography is a prime source). The auding and reading tests described in many of these unpublished reports, and also in many published reports, comprise a true potpourri of auding and reading tasks. In most cases auding and reading tests differ in content, response task, duration, and format. This is true of the studies cited in Table 4, although many of the studies conducted to obtain reliability and validity data for the construction of standardized tests at least used materials that were equivalent with regard to content and format. The data presented for Spearritt's sixth-grade study are means of some 36 correlation coefficients between nine measures of auding and four measures of reading. In his study, the *r* of .49 is for girls and the *r* of .52 is for boys.

Table 4

Correlation Coefficients for Auding and Reading Test Performance at Different School Grades

Grade Level	Correlation	Reference
1	.23,.29,.38,.18,.27,.33,.31,.41,.42, .25,.32,.42	Bond, G. and Dykstra, R. 1967
	.40,.44	Calfee, R.C. and Venezky, R.L. 1969
	.44,.39	Tiegs, E.W. and Clark, W.W. 1970
	.50	Cooperative Primary Tests 1970
2	.46	Watkins, M.C. 1960
	.45	Biggins, M.E. 1961
	.40,.36 .32,.32	Tiegs, E.W. and Clark, W.W. 1970
	.50	Cooperative Primary Tests 1970
3	.70	Biggins, M.E. 1961
	.58	Cooperative Primary Tests 1970
	.39,.30,.35,.31,.63,.49,.56,.48	Durrell, D.D. and Brassard, M.B. 1969

(Continued)

Table 4 *(Continued)*

Correlation Coefficients for Auding and Reading Test Performance at Different School Grades

Grade Level	Correlation	Reference
4	.52,.60,.55,.60,.59	Young, W.E. 1930
	.65	Joney, O.L. 1956
	.60	Ferris, M.E. 1964
	.56,.45,.61,.54,.68,.57,.64,.59	Durrell, D.D. and Brassard, M.B. 1969
5	.60,.66,.55,.53,.61,.56,.57	Young, W.E. 1930
	.66,.46,.68,.51,.72,.62,.63,.64	Durrell, D.D. and Brassard, M.B. 1969
	.55	Hollow, K.M. 1955
	.51,.56	Hall, R.O. 1954
6	.75,.52,.53,.60,.61,.66,.63,.70,.70, .54,.72,.72,.64,.54	Young, W.E. 1930
	.66,.55,.65,.62,.76,.69,.68,.67	Durrell, D.D. and Brassard, M.B. 1969
	.49,.52	Spearritt, D. 1961
	.68	Many, O.A. 1965
8	.75	Peterson, R.D. 1961
10	.51,.49,.58,.36,.68	Spache, G. 1950
	.55,.44,.60	Rose, E. 1958
	.65,.61,.51	Brown-Carlsen Listening Comprehension Test, 1955
11	.54	Hough, O.M. 1952
	.66,.47,.47	Brown-Carlsen Listening Comprehension Test, 1955

(Continued)

Table 4 *(Continued)*

Correlation Coefficients for Auding and Reading Test Performance at Different School Grades

Grade Level	Correlation	Reference
12	.76	Burton, M. 1943
	.60	Martin, A.W. 1958
College & Adult	.68,.53,.50,.50,.42	Larsen, R.P. and Feder, D.D. 1940
	.80	Anderson, J.H. and Fairbanks, G. 1937
	.46	Nichols, R.G. 1948
	.78	Goldstein, H. 1940
	.35	Brown, J.I. 1948
	.31,.36,.36,.38,.63	Brown-Carlsen Listening Comprehension Test, 1955
	.54	Sticht, T.G., Caylor, J.S., Kern, R.P. 1971

The relationship that emerges from these data, when *r* means at each grade level are computed and plotted as a function of grade level, is shown in Figure 6. The relationship between auding and reading grows as grade level increases up to the fourth grade, and remains fairly constant thereafter at around .58 to .60. Thus, although these data represent a conglomerate of procedures, materials, and subjects, the relationship that emerges between grade level and correlations of auding with reading is consistent with the expectation that correlations among auding and reading test performance should increase as school grade increases and children acquire adequate reading decoding skills. Further credence is lent to the data of Figure 6 when we consider the data from Loban's (1964) longitudinal study displayed in Figure 5. Both sets of data agree in suggesting an increase in the relationship between auding and reading test performance as school grade increases, and children acquire reading decoding skills for using print to develop meaning previously available only by auding.

These findings are consistent with the prediction of Hypothesis 2: Performance on measures of ability to comprehend language by auding is predictive of performance on measures of ability to comprehend language by reading, and this prediction is most accurate after the decoding skills of reading have been acquired. Furthermore, the data of Figure 6 suggest that such decoding skills are sufficiently developed by the fourth grade to permit auding and reading correlations of the maximal value obtainable by such "mixing pot" techniques as used in constructing Figure 6. Presumably, with well-designed studies in which such factors as auding and reading rate, range of difficulty of content, response mode, and

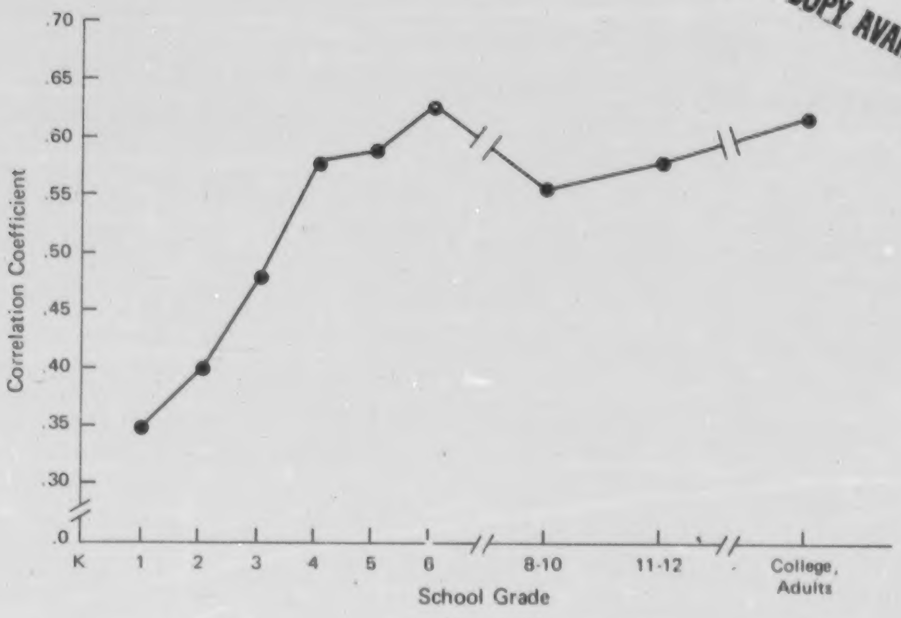


Fig. 6. **Correlation between auding and reading test performance for various studies, as a function of school grade level.**

test format were controlled, and samples broadly representative of a given age group were used, correlations would rise above the .6 level of Figure 6. Goldstein's (1940) study comes closest to fulfilling these requirements with adults, and his correlation of .78 represents about a maximal coefficient, given the reliabilities of the reading (.86) and auding (.80) tests he used. The fact of the matter is, however, that no such studies have been performed with children at different school grades, so the data of Figure 6 cannot be taken as accurately quantifying relationships between auding and reading at various grade levels.

One of the major implications of these findings is that training in oracy skills should not be expected to have much effect on reading comprehension until after the decoding skills of reading have been acquired. Thus language intervention programs should not be expected to make large impacts on reading comprehension performance until adequate decoding skills are acquired. The value of such programs should not be assessed in the first or second grades, but in the third grade and beyond, when reading decoding skills become adequate for comprehension of print, using the languaging skills and conceptual base developed by oracy training.

Stated otherwise, training in auding should not be expected to facilitate the learning of reading *decoding* skills. Rather, such training should impact on reading *comprehension.* Of course, to the extent that comprehsnsion may aid in recognizing words, development of word meanings and concepts via oracy skills may improve the likelihood that a given word encountered in print is contained in the child's oracy language base, and hence the child may recognize the word using minimal graphic cues—that is, by partial decoding. But such recognition does not imply improved decoding skills. Learning to decode means learning to make the necessary print-to-speech conversions for representing graphemes as phonemes, and for synthesizing these phonemes into pronounceable units, usually words (although certain reading decoding programs use nonsense syllables and pronounceable units to force attention to the graphic display and minimize the amount of word recognition by comprehension, *cf.*, Rodgers, 1967).

There are in fact studies (Biemiller, 1970; Barr, 1972) which indicate that oral reading errors can be analyzed to reveal whether the reader is using predominately context or graphic information for recognizing words. Readers who are depending primarily on context for "decoding" tend to make errors which are semantically consistent with the story being told. Readers who are using the graphic information to decode print-to-speech tend to make no response or to make responses consistent with the graphic information ("house" read as "horse").

By examining their oral reading errors, Biemiller identified three phases of development of reading skills in first-grade students—the first characterized by a predominant use of contextual information, the second by a predominant use of graphic information, and the third by a mixed usage of context and graphic information. Biemiller concluded that:

> Data presented in this study indicate that the child's first task in learning to read is mastery of the use of graphic information, and possibly, of the notion that one spoken word corresponds to one written word. The child's early use of contextual information does not appear to greatly facilitate progress in acquiring reading skill. The longer he stays in the early, context-emphasizing phase without showing an increase in the use of graphic information the poorer the reader he is at the end of the year. Thus, the teacher should do a considerable proportion of early reading training in situations providing no context at all, in order to compel children to use graphic information as much as possible. (p. 95)

For present purposes, the point of Biemiller's and Barr's research is that the learning of decoding skills is not likely to be improved by improving languaging by oracy skills. Decoding skills may be, and perhaps should be, taught using nonmeaningful grapheme-phoneme correspondences. Reading *comprehension* on the other hand should be improved by training in oracy skills (see Hypothesis 4). Hence, auding ability, whether acquired naturally or as a result of schooling in oracy skills, ought to be predictive of reading comprehension ability after reading decoding skills have been acquired—and the data reviewed under Hypothesis 2 indicate that it is.

HYPOTHESIS 3

Hypothesis 3 states that performance on measures of maximal rates of auding and reading will be comparable, assuming fully developed reading *decoding* skills. This hypothesis follows from the fact that, in the present model, auding and reading utilize the same languaging and conceptualizing systems. Hence, the limiting factors underlying both auding and reading rate are skill in languaging and in conceptualizing.[1]

While the concept of reading rate or "speed reading" is probably familiar, readers of this report may not be familiar with the concept of auding rate or "speed auding." Essentially, auding rate refers to how well one can comprehend spoken passages presented at different rates of speech. For instance, a paragraph might be read aloud to a listener at an average rate of 150 wpm, and a comprehension test administered immediately. This procedure is then repeated for comparable materials presented at rates of 200, 250, 300, and 350 wpm. Changes in immediate retention comprehension scores are used to indicate the influence of speech rate on auding. Thus "speed auding" means auding rapidly presented rates of speech.

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[1] Note that auding and reading are subsets of the more general processes of listening and looking, respectively. Hence confirmation of the present hypothesis is evidence for the hypothesis that listening and looking rates are equal, as they should be since they are simply modality names for one internal process—focal attending (see Chapter IV, pp. 48-50).

In their 1969 review of research on rate of auding, Foulke and Sticht concluded that, when various studies are considered collectively, the relationship that emerges is one in which rate of auding comprehension declines slowly as word rate is increased, up to a rate of some 275 wpm; beyond this the decline in rate of auding comprehension is faster. Subsequently, Foulke (1971) reported data suggesting that rate of auding comprehension declined more rapidly when a wpm rate of 250 was exceeded. Carver (1973b, Figure 4) reported reanalyses of Foulke's (1971) data which indicated that, for very difficult test items, auding comprehension dropped off rapidly at 300 wpm, while for less difficult items auding comprehension declined only a little over the range of speech rates from 125 to 400 wpm. In Figure 5 of the same article, Carver presents data of his own indicating that subjects' *judgment* of how well they understood spoken messages presented at various rates dropped off gradually for speech rates from 100 to 300 wpm, and then declined rather rapidly at rates beyond 300 wpm.

Carver also presented evidence (Figure 6 of his article) to suggest that a "threshold" for comprehending auding materials might be surpassed at speech rates as low as 150 wpm, depending upon how comprehension is measured (e.g., multiple-choice tests, judgments of understanding). However, in a subsequent unpublished paper, Carver (1973c) presents additional data to suggest that, for college students, auding comprehension drops precariously when rates exceeding 300 wpm are presented. Thus, although research exists to suggest that auding comprehension may or may not decline at rates of speech less than or equal to 250-300 wpm, evidence is strong for suggesting that rates above these levels will almost certainly lead to rapid losses of information by auding.

Regarding speed auding, then, current research indicates that, although most information that is presented for auding does not demand processing rates in excess of 150-200 wpm (newscaster; professional readers for the blind typically read aloud at around 175 wpm±25 wpm, Foulke and Sticht, 1969; Foulke, 1969), high school graduates and college students can aud at rates up to 250-300 wpm before their capacities for rapidly processing language information are overtaxed. If this represents some upper limit in rate of languaging, then the present model predicts that once reading skill is acquired, it will reflect this same limit in rate of languaging.

Data bearing on normative rates of silent reading are available from the recent (1972) National Assessment of Educational Progress (Report 02-R-09). This survey measured the rate at which respondents aged 9, 13, 17, and 26-35 (young adults) silently read materials with the knowledge that they would be tested for comprehension (memory for details) immediately afterward.

Data from the National Assessment report are summarized in Table 5. While a clear growth in reading rate is evident from 9-year-olds to 17-year-olds, there is no evidence for silent reading rates in excess of the 250-300 wpm reported previously for upper ranges of auding rates. For 17-year-olds and young adults, only some 10% of the samples read in excess of 300 wpm. Only 17 people out of the 7850 tested at all age levels read in excess of

Table 5

Rate of Silent Reading for Four Age Groups[a]

Age (years)	N	Passage	Grade Level of Materials[b]	Reading Rate at Percentile[c]		
				25	50 Median	75
9	2195	1	4-8	86	117	158
		2	7-12	88	123	169
13	2196	1	5	133	173	217
		2	10-11	128	165	212
17	2220	1	10	160	195	247
		2	College	157	195	246
26-35	1239	1	10	145	188	231
		2	College	145	186	236

[a] Data are from National Assessment of Educational Progress Report 02-R-09: Reading Rate and Comprehension, 1970-71 Assessment, December 1972.

[b] Grade levels are readability scores determined by 3 to 4 different readability formulas. Data presented are ranges.

[c] Reading rates are words per minute (wpm).

750 wpm—and these readers could not consistently answer four out of five of the comprehension questions for two selections.

There is little evidence here, then, that people "typically" read at rates far in excess of rates they can contend with by auding. In fact, the median rates of silent reading for 17-year-olds and young adults are not too much higher than the 175 wpm average *oral* reading rates of professional newscasters and readers for the blind (*cf.*, Foulke and Sticht, 1969). It is also relevant to note that trained oral readers *can* produce speech rates as fast as 220-344 wpm when asked to produce maximal, yet intelligible rates of speech (Goldstein, 1940; Carroll, 1971; Miron and Brown, 1971). These rates of reading aloud are fast enough to encompass the range of the silent readers at the 75th percentile in Table 5. They are also within the range of silent reading rates for college students, which are typically found to be in the vicinity of 250-300 wpm (Gray, 1956; Taylor, 1964).

It appears that college students typically read silently at rates comparable to those at which auding can be performed, without serious decrements in comprehension. In turn, both auding and reading rates of college students seem to correspond to the upper rates at which oral reading can be produced. This suggests a common factor underlying all three processes, an idea we shall return to later in this section.

The evidence reviewed regarding the comparability of auding and reading rates does not include direct comparisons of auding and reading. There are, so far as we can determine, only a handful of studies that make such a direct comparison. In an early study of the effects of rate of presentation of messages on auding and reading comprehension, Goldstein (1940) presented spoken messages to adults at 100, 137, 174, 211, 248, 285, and 322 wpm. He found that comprehension scores, expressed in school grade equivalents, decreased as 11.1, 10.8, 10.6, 10.5, 9.4, 9.3, and 8.7, respectively. Thus, increasing the rate of presentation decreased the amount of information available to be used in answering the comprehension questions. The largest drop occurred between 211 and 248 wpm, with a decrease from 10.5 to 9.4—a 1.1 grade-level drop.

In the same study, Goldstein also presented materials for reading at different rates using a moving picture projection technique to control rate of appearance of the printed text. For the same rates—100, 137, 174, 211, 248, 285, and 322 wpm—comprehension scores decreased as 10.6, 10.1, 10.1, 9.8, 9.4, 9.1, 8.7. It should be noted that the auding and reading comprehension scores are quite similar, and that both auding and reading scores decrease with increasing rates of presentation.

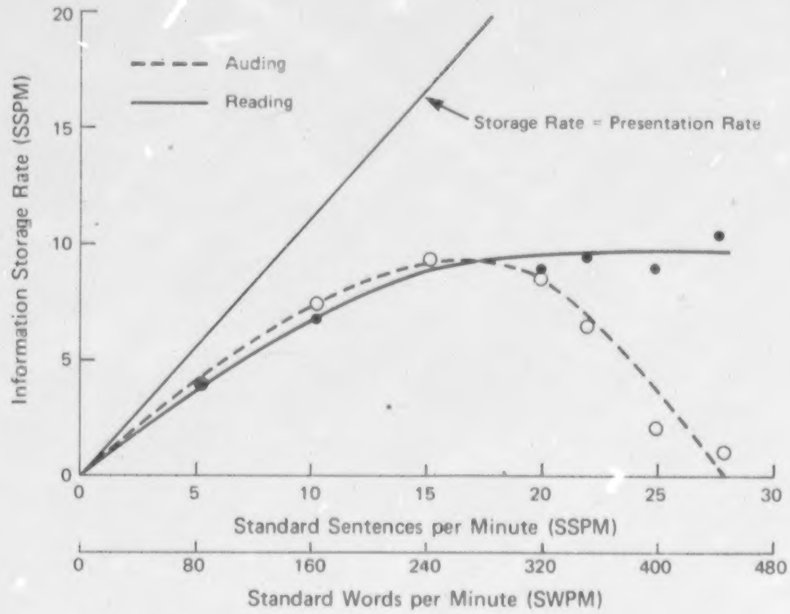
Jester and Travers (1966) presented passages for auding and reading at rates of 150, 200, 250, 300, and 350 wpm. For auding, their college students had mean retention comprehension raw scores of 14.7, 14.2, 7.3, 4.9, and 5.2 respectively. Corresponding reading scores were 15.5, 10.8, 9.1, 10.1, and 5.9. It is clear that at the fastest rate (350 wpm) auding and reading scores are comparable, while at 300 wpm reading is clearly superior to auding (10.1 to 4.9). On the other hand, auding surpassed reading at 200 wpm. At best then, these data are inconclusive. It seems unlikely that reading would be more effective than auding at 300 wpm, less effective at 200 wpm, and equally effective at 150 wpm—especially since both Mowbray (1953) and more recently Young (1973) found no differences in college students' auding and reading retention comprehension scores when materials were presented at 175 wpm, with reading rates being paced by moving displays of print as in Goldstein's study. Perhaps discrepancies between Goldstein's work and that of Jester and Travers relate in some way to the fact that the latter researchers used slide projection to present non-moving print displays. Whatever the case, it is clear that at the fastest rate—350 wpm—Jester and Travers found auding and reading performance to be comparable. Thus there is no indication of great differences in rate of languaging favoring reading.

Carver (1973c) presents the most analytic discussion of the relationship between auding and reading rates found by these reviewers. He presented auding and reading passages to 108 college students at rates ranging from 75 to 450 wpm. Actually, reading rate was not directly manipulated; rather, time for reading was limited to the duration needed to present the passages for auding, a methodological point which will bear on Carver's findings described below.

Comprehension was measured using subjective judgments by subjects concerning the percent of thoughts contained in the passages that they estimated they understood. This measure had previously been demonstrated to be a valid, reliable method of measuring comprehension (Carver, 1973a).

The objective number of thoughts in each passage was specified operationally as the number of standard-length sentences in each passage, with a standard-length sentence defined as 16 five-letter words. For the study under discussion, the passages presented for auding and reading contained an average of 20.8 standard sentences. To calculate the rate of presentation of messages in standard sentences per minute (SSPM), 20.8 was divided by the time needed to present the messages at each of the rates from 75 to 450 wpm. This number Carver called the information *presentation* rate. The percent of these standard sentences which subjects estimated they understood was used to index the information *storage* rate. One question raised, then, is whether subjects *store* information as fast as it is presented, or is there some optimal rate of *storage* which, when exceeded by the *presentation* rate, results in decreased *storage*. A second question is whether auding and reading might differ in regard to optimal information *storage* rates, if such are found.

Figure 7 presents data adapted from Carver's report. There appears to be an obvious optimum for auding between 15-20 SSPM or 240-320 SWPM. These data are consistent with the data regarding speed auding reviewed earlier. The apparent lack of an optimum for reading storage rate reflects the methodology used to manipulate reading rate in which only the *time* for reading was manipulated, not the actual rate of appearance of the printed information. The reading data reflect the fact that subjects were told to read at their normal rates. Thus, with less time to read subjects learned less material. But since both time and amount read decreased together, the ratio formed by dividing amount read by time to read it stayed constant at nine standard sentences per minute. This suggests that students were presenting information to themselves by reading at an average rate of 16-19 SSPM, or 250-300 SWPM—rates comparable to the optimal rates found for auding. If we assume that students typically read at rates which they feel are optimal for them, then we may conclude that auding and reading showed comparable optimal rates.



NOTE: Adapted from Carver, 1973 ©, with permission of the author.

Fig. 7. **Information storage rate as a function of information presentation rate for auding and reading.**

To summarize briefly, research reviewed indicated that: (a) Typical oral reading rates for professional oral readers (newsmen; readers for "talking books" for the blind) are around 175 wpm, with a standard deviation of 25 wpm, hence *auding* rates of 175 wpm are typical for persons auding such presentations. (b) A national sample of 17-year-olds and young adults silently read at rates of 185-195 wpm, suggesting that, typically, such persons do not read silently much faster than they aud newscasts or radio programs. (c) When requested to read aloud as rapidly as possible without loss of intelligibility, trained oral readers can produce speech rates as high as 250-340 wpm. (d) When adults are presented spoken materials for rapid auding, comprehension typically holds up well for speech rates up to 250-300 wpm, then declines more rapidly. (e) A national sample of 17-year-olds and adults showed less than 10% of the population reading above 300 wpm, with the 75th percentile reading at 231-247 wpm; additional studies indicate that high school students and college students—that is, the better readers in the country—typically read at rates of 250-300 wpm. (f) Studies which have directly compared the effectiveness of auding and reading, at different rates of presentation of the material up to 350 wpm, show comparable levels of comprehension for the two processes at the fastest rates.

From the foregoing we conclude that, to date, there is no clearly demonstrated superiority for the reading process in rate of processing language information from print over what can be accomplished by the auding process in processing language information from speech. Rather, the available data suggest that both auding and reading processes may operate at the same rates of efficiency when the rate of presentation of language material is directly manipulated. This conclusion is consistent with the assertion in the developmental model that reading utilizes the same languaging capabilities as auding. Hence, the rate at which languaging can be executed limits both the rate of auding and subsequently the rate of reading when that skill is acquired.

Speculation on the Rate of Languaging. It is of interest to note that the rates of 250-300 wpm, indicated by the foregoing as more-or-less "maximal" rates for auding and silent reading, correspond closely to the fastest rates at which trained readers can read aloud. This suggests that the same factors which limit rates of reading aloud may limit rates of auding and reading. One factor limiting oral reading is the rate at which articulatory movements can be made. Lenneberg (1967, pp. 88-124) discusses various aspects of speech production, including the rate at which articulatory movements (syllables) can be made. He reports that ". . . subjects between the ages of eight to about thirty could speed up production to eight and occasionally even nine syllables per second for the duration of a few seconds; the rate slowed down to about six per second if the alternating movements were to be sustained over more than three or four seconds." (p. 115)

Taking six syllables per second as an efficient level of production gives 360 syllables per minute. Then, assuming 1.42 syllables per word (the average for 33 of the 36 passages scaled for complexity by Miller and Coleman, 1967; Carroll, 1967 describes six passages with an average of 1.44 syllables per word), we obtain a rate of 254 wpm—a rate comparable to the average silent reading rate of high school students (Taylor, 1964). A rate of 300 wpm corresponds to a syllable per second rate of 7.1, midway between Lenneberg's rates of six syllables per second for sustained production, and nine syllables per second for brief durations of production.

There appears, then, to be a close relationship between the rate at which syllables can be produced, and maximal auding and silent reading rates. It is as though, typically, auders and readers utilize the same mechanisms for decoding spoken or printed language into conceptualizations, as are used in signaling conceptualizations to others via speech.

This is, of course, an old idea. Huey (1908; reprinted in 1968) devotes two chapters to the role of "inner-speech" in reading. He states: "The simple fact is that the inner saying or hearing of what is read seems to be the core of ordinary reading, the 'thing in itself', so far as there is such a part of such a complex process." (p. 122) While elsewhere Huey states that the fact of inner speech forming a part of silent reading has not been disputed (p. 117), Kolers, in his introduction to the 1968 printing of Huey's book, expresses the kind of ideas that have obscured the relationship between languaging and auding and reading when he states that: "People who read faster than about three or four hundred words per minute, and certainly those who read at rates of a few thousand words per minute, simply have not enough time to form an auditory representation of all they read." (p. xxvii).

Of course, Kolers gives no data to indicate that people *can* read a "few thousand words per minute". In fact, Taylor (1962) presents eye movement records which clearly indicate qualitative differences between "normal" reading and "reading" at 3000 or more wpm. The latter recordings indicate that the "rapid reading" eyes move in a completely different manner than do the "normal reading" eyes. The latter move systematically to the right across a line of print making three or four stops (fixations), and then make a return sweep to the left margin and begin to move to the right again. The "rapid reading" eyes, on the other hand, may move down the left margin for 10 or so lines, then jump to the right margin for 10 lines or so, then back to the left, and so on, quite clearly doing something other than "normal reading."

Thus, while "skimming" or "scanning" can most certainly be accomplished with printed displays, there is little evidence that readers can, or typically do, read at rates far above the rates at which they can aud or speak (see Edfeldt, 1960; Sokolov, 1972, pp. 202-211, for further discussion and research on inner speech and reading; Carver, 1971a for discussion of "speed reading").

The upshot of this analysis is that much of silent reading appears to involve the conversion of printed symbols into the same type of signing systems used in receiving and expressing oral symbols, which are then converted into, or directly give rise to, conceptualizations. Thus, the representation of meaning *directly* by written language does not appear to be a typical happening, as some have argued is the case with skilled readers (Goodman, 1973; Smith, 1971, pp. 44-45—again we see here the claim that ". . . trained readers can cover [but not read one by one] many thousands of words in a minute" with no evidence given, and with a failure to carefully distinguish reading from skimming or scanning).

The fact that the maximal rates of syllable production closely match the optimal auding and reading rates should not be taken to necessarily imply the syllable as the "basic" unit of language. It may be, but there are many problems in adequately defining syllables (Shuy, 1969) both as units of speech and as units of print. For present purposes, it is sufficient to note the similarities among rate of syllable production (movement of articulators), rapid auding, and rapid reading, and to point out the relevance of this observation to Hypothesis 3 and the developmental model.

Speculation on the Rate of Conceptualizing. Lenneberg (1967, p. 90) points out that, while most adults are capable of producing common phrases or clichés at rates up to 500 syllables per minute, more frequently they speak at 210 or 220 syllables per minute (150 wpm). He then states: "Apparently, the most important factor limiting the rate of speech involves the cognitive aspects of language and not the physical ability to perform the articulatory movements. We may not be able to organize our thoughts fast enough to allow us to speak at the fastest possible rate."

It is likewise possible that in auding and reading we may not be able to merge the thoughts being presented with our own conceptual base fast enough to "track" the oral or printed message. Possibly it is primarily lack of conceptualizing time which causes the gradual loss in comprehension when auding and reading speech are increased up to 250-300 wpm. Beyond 300 wpm then, the loss in comprehension may reflect both lack of conceptualizing time and inability to mobilize inner articulatory patterns rapidly enough to faithfully follow the message.

Evidence that ability to rapidly conceptualize is related to ability to comprehend rapid rates of speech is available in a study by Friedman and Johnson (1969). They administered a group of cognitive tests to college students who also auded materials presented at 175, 250, 325, or 450 wpm. One of the cognitive tests—the Best Trend Name Test—requires students to infer the semantic relationships among a set of words. For example, the words "horse-pushcart-bicycle-car" are presented and the student is asked to decide whether the relationship among the four terms is best described as one of "speed", "time", or "size". The correct answer is "time" since the sequence describes an order of historical development, horses were the earliest means of transportation, cars the most recent.

Results of multiple regression analyses for predicting auding ability at each of the four rates listed indicated that while the Best Trend Name Test was a poor predictor of performance at the slowest rates, its correlation and beta weight increased significantly with the fastest rate of speech, identifying it as a major source of individual variance in the comprehension of highly accelerated speech. Thus, the ability to efficiently conceptualize semantic relations among vocabulary items facilitates comprehension of more rapid rates of speech.

The role of conceptualizing ability in comprehending auding materials is also demonstrated by the fact that, even at rates of speech of from 125 to 175 wpm, high aptitude men do not learn as much from materials written at grade level 14.5 or 8.5 as they do from materials of grade 5.5 difficulty (Sticht, 1972). Thus the effects of difficulty level of material appear to represent conceptualizing rather than languaging (encoding and decoding conceptualizations into and out of forms for communication) difficulties at normal rates of presentation, although research does not rule out the possibility that higher grade level materials may be more difficult to encode and decode for some individuals.

The role of conceptualization ability, or ability to "organize our thoughts," in comprehending auding messages presented at various rates is also evidenced by the differences in performance between "high" and "low" aptitude students. Sticht (1972) found that men of low verbal aptitude did not learn as much auding fifth-grade materials presented at 150 wpm as high verbal ability men did at 350 wpm. In another study (Sticht, 1968) it was found that low verbal ability men learned passages of 6th, 7th, and 14th grade level of difficulty as well by auding as they did by reading when materials were presented at 175 wpm, but in neither case did they do as well as higher verbal aptitude men. Thus "low aptitude" or "low verbal" intelligence seem more likely to represent conceptualization problems than problems associated with rapid encoding or decoding of concepts into language to send or receive ideas.

The point we are making is that performance on immediate tests of retention of information typically used to evaluate auding and reading ability at various rates of presentation reflects a combination of the ability to encode and decode information from the conceptual base into or out of spoken or printed representations of our concepts, and the ability to formulate and reformulate concepts in keeping with the message being sent (speaking) or received (auding or reading). Other things being equal, the former ability will interfere with performance when rates of information display exceed 300 or so wpm, while the latter ability will hinder or facilitate performance over all ranges of rates of presentation, and can be demonstrated by manipulating the difficulty levels of materials and the "mental aptitude" of the students. We are inclined at the moment to call the former a languaging problem, and the latter a conceptualizing problem.

While it is difficult to demonstrate the separate functioning of languaging and conceptualizing processes, we will describe an unpublished study by Sticht and James which we believe demonstrates the separate functioning of the decoding component of languaging by reading from other ongoing languaging and conceptualizing processes.

In this study college students of high verbal ability and marginally literate men of low verbal ability were asked to aud a fifth-grade level story about Roland and Charlemagne. At the same time they were provided with a typed copy of the story which they were to read as they auded. Occasionally there was a mismatch between what was on the printed page and what was in the spoken story being auded. For instance, the spoken story might state "With the air of a *lord* he walked. . .", while the printed story would state "With the air of a *prince* he walked. . .". Thus the mismatch was not semantically detectable; rather there was a discrepancy between the graphic word and the spoken word. When students encountered a mismatch, they were instructed to circle or check the printed word which did not match the spoken word. By counting the errors students made in "tracking" the auding and reading passages, an index of how well students could convert auding and reading materials into some comparable internal form and compare them was obtained.

Measures of immediate retention (multiple-choice tests) were used to index how well students could conceptualize what they were auding and reading. To assess the effects of rate of presentation, one-third of the story was presented at 128 wpm, one-third at 228 wpm, and one-third at 328 wpm. Tracking and immediate retention scores were obtained for each rate of presentation.

Results are presented in Figure 8. Notice first that college students were able to maintain high conceptualization rates (immediate retention) over the three rates of presentation of this very simple, 5th grade story. However, their tracking scores dropped significantly as rates were increased. We interpret these data according to the flow chart of Figure 9. In performing this task, students first form an internal representation of either the auding message or the reading message. Here we have assumed that the auding message is internally represented first, because it sets the pace, which is especially important at the faster rates of speech. The internal auding message is then related to the conceptual base (Sequence A) and stored in short-term memory (STM) (Sequence B). Then the print is decoded into an internal representation of the same form as a spoken word, in keeping with the developmental model, and stored in STM. There the two representations are compared. If they match, the cycle is repeated. If not, the circling or checking response is made and then the cycle is repeated.

So long as the slower rates of presentation are used, the college students have no trouble performing all of the foregoing processes (and probably others which we have not bothered to separate out). However, at the faster rates, the processes involved in Sequence B become too time consuming, and so the college students drop some of the decoding print-to-speech and matching processes in favor of tracking the auding message to store information in the conceptual base for use in taking the immediate retention test. We suspect they emphasize auding rather than reading because, if they ignored the auding message, they could not do the mismatch task, yet their tracking scores are not zero, so they are doing some of the Sequence B processes, and the auding message again sets the pace for these processes.

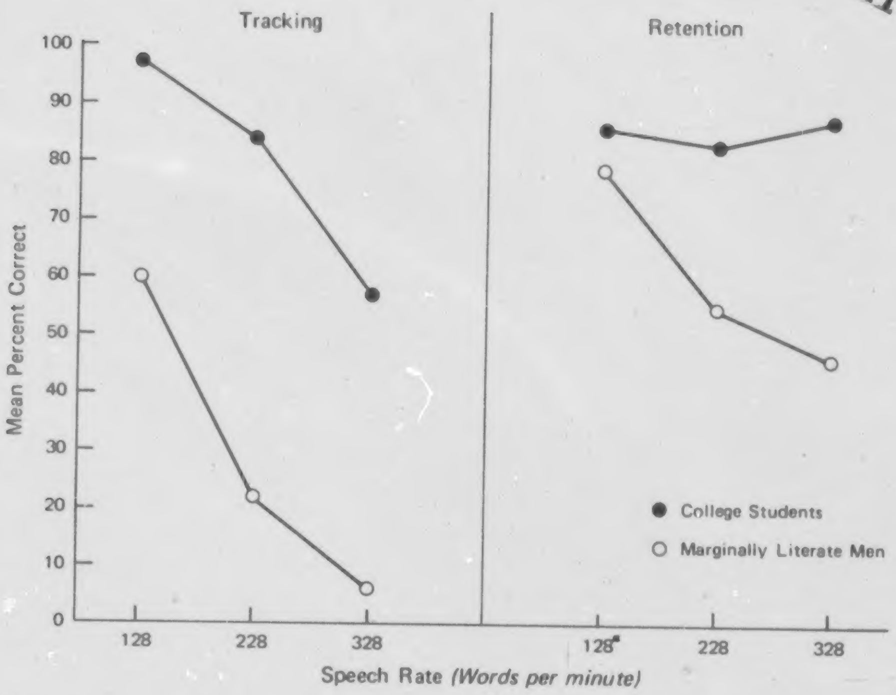


Fig. 8. **Tracking and retention performance at three speech rates for college students and marginally literate men.**

The data for the marginally literate men (MLM) again illuminate differences between languaging and conceptualizing processes. At the slowest rate of presentation, 128 wpm, these men were able to aud and conceptualize almost as well as the college students, as indicated by their immediate retention scores. Their tracking scores, on the other hand, are almost 40% below the college students, indicating that the marginally literate men (MLM) could not perform the Sequence B activities very well—which is reasonable since these activities are *reading* activities, and these men are not skilled readers (i.e., decoders of print to internal spoken form). However, we note also that the MLM have difficulty with the Sequence A processes at the faster speech rates. They are unable to conceptualize the information even by auding as well as the college students do when faster speech rates are used (again, we assume from the very low tracking scores, which are almost always errors of omission rather than commission, that the MLM are dropping reading processes in favor of auding processes; this seems reasonable because of the low reading skills—fifth-grade level—of these men, and because the auding message sets the pace).

The foregoing analysis, although it is obviously incomplete and fragmented (What are the subprocesses in Sequence A? How is the interface between languaging and conceptualizing processes to be construed?), serves to illustrate the distinction we are making between languaging and conceptualizing. More to the point of Hypothesis 3, however, the arguments and studies cited above tend to support the notion that reading utilizes the same languaging and conceptualizing skills used in auding. Limitations in the rates at which languaging and conceptualizing can be performed place upper limits on both auding and reading.

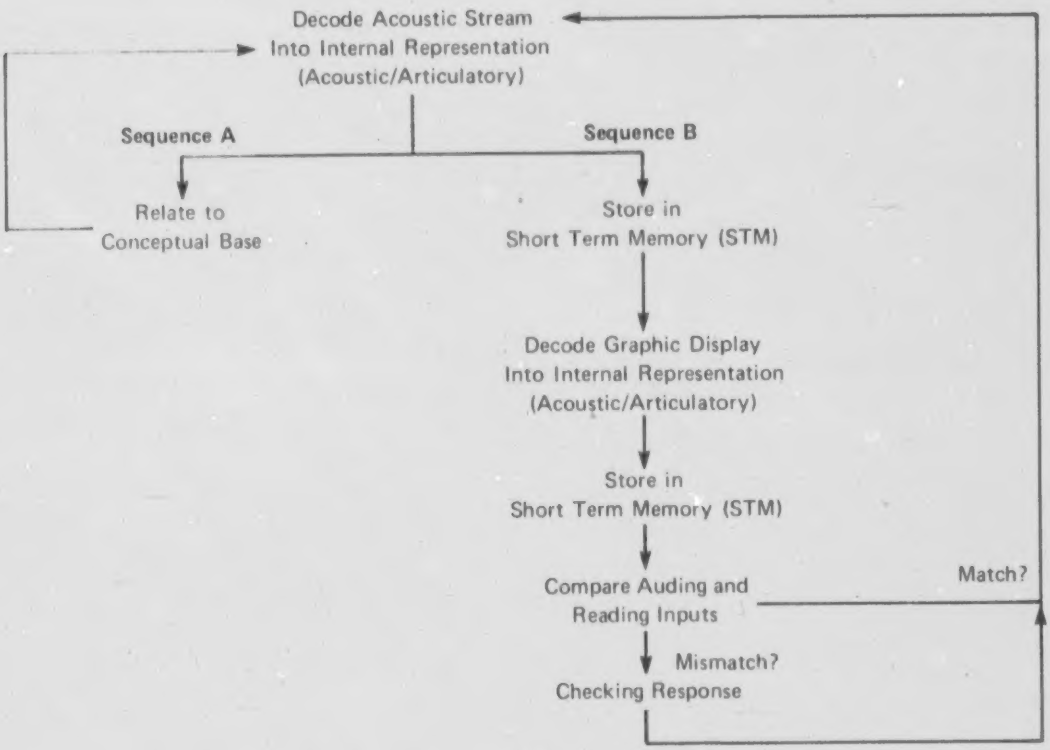

Decode Acoustic Stream
Into Internal Representation
(Acoustic/Articulatory)
Sequence A
Sequence B
Relate to
Conceptual Base
Store in
Short Term Memory (STM)
Decode Graphic Display
Into Internal Representation
(Acoustic/Articulatory)
Store in
Short Term Memory (STM)
Compare Auding and
Reading Inputs
Match?
Mismatch?
Checking Response

Fig. 9. **Flow chart of tracking and retention behavior.**

Perhaps conceptualizing ability can be improved through education and training in reasoning. Languaging ability seems limited by physiological factors involved in articulating. Hence training in rapid auding or reading will most likely have to focus on training the auder or reader to *ignore* much of what he hears or sees, and to sample messages through scanning and skimming techniques using cues such as pauses and inflection for rapid scanning of speeded speech, and italics, indentations, and underlinings for scanning print displays.

While languaging is obviously involved in such processes whenever the ear or eye fix on a segment of a message, the conceptualization processes must play the major role in synthesizing a meaningful story out of fragments of the message. If such rapid conceptualizing is to be accomplished, a person must have a plan for attacking the materials, and this plan will be more faithfully executed when the display is under the control of the scanner. Thus, the reading display lends itself to such rapid scanning, and this may be what happens when we hear of "reading" at 3,000, 4,000, or even 1 million (!) words per minute. But it is clearly *not* what the "typical" reader does in "typical" situations, and hence the study of such processes is beyond the scope of the present review.

At the present time, the data suggest that auding and reading utilize the same languaging and conceptualizing processes, and hence offer confirmatory evidence for Hypothesis 3 and the developmental model. We turn now to a 4th hypothesis generated by the model.

HYPOTHESIS 4

The fourth hypothesis derived from the developmental model concerns the transfer of training between auding and reading. The hypothesis is that, because auding and reading share a common language and cognitive content base, effective training in comprehending by auding will transfer to comprehending by reading, as that skill develops. This hypothesis, in slightly different form, has been examined elsewhere (Cooper, 1966; Reddin, 1969; Devine, 1968), with conflicting conclusions reflecting, it seems to us, failure to adequately consider the conditions needed to demonstrate transfer.

Because of the importance of these conditions, our critique of the auding-reading transfer research literature will be guided by what we believe to be the proper transfer paradigm for such work. This paradigm is exemplified in the following diagram:

Group		Training	Measure of Training Effectiveness	Measure of Transfer
Experimental	Pretest on A_1 and B_1	Training on A	Posttest on A_2	Posttest on B_2
Control	Pretest on A_1 and B_1	Non-related activity	Posttest on A_2	Posttest on B_2

The important elements of this paradigm are (a) the administration of a pretraining test of those skills to be measured on both the test of training effectiveness and the test of transfer; (b) the creation of equivalent experimental and control groups on the basis of these pretraining scores; (c) the presentation of the training program (auding) to the experimental group during a period when the control group experiences some activity non-related to either the training given to the experimental group or the measure of transfer; (d) the administration of a post-training measure of A to both groups to determine the effectiveness of the training program; and finally, (e) the administration of the post-training measure of transfer (reading to both groups).

As pointed out by Cooper (1966), much of the transfer research is contaminated by the omission of a post-training auding measure. Because of this omission, an important element in the transfer paradigm is bypassed. Transfer could be expected between *A* and *B* only if this training actually produced an effect on *A*. Without a post-training measure of *A* it becomes extremely difficult to interpret the measure of *B*. Is lack of change in *B* due to a failure in transfer or a failure of original training to affect *A*? Conversely, a change in *B* is opened to multiple explanation without evidence that training affected *A*.

With these conditions in mind, we turn now to the literature bearing on the transfer problem. As mentioned earlier, a number of college and university libraries have a policy of nondissemination of theses and so some studies could not be obtained for examination. However, 23 solicited reports were eventually received and reviewed as primary sources. In addition to the 23 studies reviewed in their entirety as primary sources, Dissertation Abstracts and Duker's (1968) abstracts provided limited information on eight additional tests of the transfer hypothesis. Thus, information is included in Table 6 for a total of 31 studies bearing on the transfer hypothesis.

Table 6

Information Sketch of 31 Auding-Reading Transfer Studies

Reference	Subjects	Duration of Instruction (hours)	Did Training Result in Auding Improvement?	Was a Significant Transfer Effect Found?
Childers, D.B. 1963	3rd graders (N = 70)	?	Not analyzed	Not analyzed
Cole, Sister M.E. 1961	1st graders (N = 141)	25	Yes	Yes
Cooper, J.L. 1966	8th graders (N = 153)	27	Yes	Yes
Feldman, S.C., *et al.* 1968	3rd graders; disadvantaged readers (N = 64)	58	No	No
Flederjohann, W.C. 1965	3rd graders	7	Yes	Yes
Harris, D.P. 1965	Kindergarten (N = 40)	9	Not measured	No
Hill, E.S. 1961	College freshmen (N = 96)	12	Yes	Yes
Hollingsworth, P.M. 1964	8th graders (N = 291)	2 1/2	No	No
Kelty, A.P. 1953	4th graders (N = 188)	7 1/2	Not measured	No
Kohls, M.P. 1965	4th graders (N = 149)	10	Yes	Yes
Laurent, M. 1963	5th & 6th graders (N = 630)	10	Yes	No
Lewis, M.S. 1952	4th, 5th & 6th graders (N = 270)	7 1/2	Not measured	Yes
Lewis, R.F. 1963	College students (N = 177)	?	No	No
Lubershane, M. 1962	5th graders (N = 72)	6 1/2	Not measured	Not meaningfully analyzed
McCormack, Sister M.E. 1962	1st graders (N = 88)	36	Not measured	Yes
McDonnell, Sister M.P. 1962	1st graders (N = 63)	?	Yes	Yes
McPherson, I. 1951	2nd graders (N = 130)	?	Not measured	Yes
Madden, T.M. 1959	5th graders (N = 200)	7	No	No
Marsden, W.W. 1952	5th & 6th graders (N = 232)	9	Not measured	Yes
Matthews, Sister J.L. 1958	3rd graders (N = 230)	24	Yes	No

(Continued)

Table 6 *(Continued)*

Information Sketch of 31 Auding-Reading Transfer Studies

Reference	Subjects	Duration of Instruction (hours)	Did Training Result in Auding Improvement?	Was a Significant Transfer Effect Found?
Merson, E.M. 1961	4th graders	?	Yes	No
Prater, H. 1965	4th graders (N = 59)	14	Yes	Yes
Raper, K.A. 1951	6th graders (N = 30)	2	No	No
Reddin, E. 1968	4th, 5th & 6th graders (N = 381)	18	Not measured	No
Reeves, H.R. 1965	4th graders (N = 444)	7 1/2	No	No
Skiffington, J.S. 1965	8th graders (N = 153)	11 1/2	Yes	Yes
Taylor, H.S. 1964	3rd graders (N = 48)	40	?	Yes
Thorn, E.A. 1968	1st graders (N = 132)	?	Yes	Yes (p = .06)
Veronese, J.P. 1960	9th graders (N = 44)	9 1/2	Yes	Yes
Withrow, E.M. 1950	7th, 8th & 9th graders, disadvantaged readers (N = 62)	27 1/2	Not measured	No
Wygand, L. 1966	3rd graders (N = 56)	7 1/2	Not measured	No

Eleven studies (Withrow, 1950; McPherson, 1951; Lewis, 1952; Marsden, 1952; Kelty, 1953; Lubershane, 1962; McCormack, 1962; Taylor, 1964; Harris, 1965; Wygand, 1966; Reddin, 1968) fell subject to Cooper's (1966) criticism given above; that is, they failed to report a post-training auding measure. Five of these studies actually reported a significant effect of training on reading, but due to their omission of post-training auding measures, all 11 studies were dropped from further consideration as tests of the transfer hypothesis.

The study by Childers (1963) concluded that a group of subjects given auding training demonstrated greater gain in both auding and reading than did a group of controls. Because of the omission of a formal analysis of the data, however, we excluded this study from serving as a measure of the strength of the transfer hypothesis.

Seven studies (Feldman, *et al.*, 1968; Hollingsworth, 1964; Lewis, 1963; Madden, 1959; Matthews, 1958; Raper, 1951; Reeves, 1965) failed to achieve a significant improvement in auding ability in their training programs, and, not surprisingly, found no improvement in reading ability. While such results are not incompatible with the transfer hypothesis, they do not constitute positive demonstrations of the transferability of training between auding and reading.

Of the 12 remaining studies of Table 6, two (Laurent, 1963; Merson, 1961) were reported as showing improved auding with no transfer to reading, while of the 10 remaining studies incorporating a post-training auding measure into their designs, all reported a significant improvement in auding on the basis of this measure, and all found an improvement in reading ability paralleling the improvement in auding ability (Veronese, 1960; Flederjohann, 1965; Cole, 1961; Hill, 1961; McDonnell, 1962; Kohls, 1965; Prater, 1965; Skiffington, 1965; Cooper, 1966; Thorn, 1968).

The two studies which failed to support the hypothesis (Laurent, 1963; Merson, 1961) were not available for full evaluation, and hence we have no means for understanding why they failed to support the hypothesis. Nonetheless, the weight of the evidence appears to be in favor of the hypothesis that training in comprehending by auding transfers to comprehending by reading. (No studies on reading to auding transfer were found, although this should occur.)

The strength of the support provided by the 10 studies reporting transfer is increased by their diversity along two dimensions: grade level and training time. Reddin (1968) has previously voiced caution concerning the acceptance of auding-reading transfer without regard to the grade level of the subjects. This cautionary note appears less critical in light of the 10 studies supporting the transfer hypothesis. In these studies, subjects ranged from first-grade students (Cole, 1961; McDonnell, 1962; Thorn, 1968) to college freshmen (Hill, 1961). These studies also varied with respect to the duration of auding training. The shortest training period was approximately seven hours (Flederjohann, 1965) and the longest approximately 27 hours (Cooper, 1966).

While seven hours of instruction appears somewhat brief, the transfer hypothesis has been tested on the basis of far less training. Raper (1951) based his study on some two hours of training, while Hollingsworth used approximately 2 1/2 hours of training. The failure of training in these two studies might easily have been due to this factor.

A factor which appears important for the occurrence of transfer from auding training to reading ability is the similarity or degree of correspondence (Reddin, 1968) between the knowledges and skills taught in the auding program and the knowledges and skills tested in the measure of reading ability.

A striking similarity among the studies reporting positive transfer is found in the content of the auding training programs. Six of these studies included training in "listening in order to recall events, ideas, or details"; five included training in "vocabulary"; five provided training in "listening to predict outcomes or to draw conclusions or inferences"; and four provided training in "listening to follow directions." Seven studies had at least two of these training elements in common.

An analysis of the reading measures employed in this work reveals a fair degree of correspondence between the nature of the auding training provided and the reading skills measured. These studies all employed standardized reading tests (Gates Primary Reading Tests; Iowa Silent Reading Test; SRA Reading Record; California Achievement Test, Elementary Reading Section; Dominion Achievement Tests, Reading; Metropolitan Achievement Tests, Reading) to measure for transfer. As might be expected, all of these tests are heavily loaded with vocabulary items. The task of recalling details is specifically identified as a part of the Iowa Silent Reading Tests, the SRA Reading Record, and the California Achievement Test, Elementary Reading Section. The Gates Primary Reading Tests are in essence a measure of a student's ability to follow directions and this ability surely affects performance on this entire set of measures.

Generally speaking, the studies reporting significant transfer are characterized by a fairly high level of correspondence between auding training and reading transfer measures. This is consistent with the assumption in the developmental model of a common denominator for both auding and reading; this denominator is the more central ability of *languaging*, including the signs (vocabulary) and rules for using the signs in inter- and intra-personal communication (comprehension skills) and the cognitive content. When training and transfer test correspond, the probability is increased that the altered *languaging* skills and the new cognitive content will in fact be sampled.

Overall, then, available research appears to support the transfer hypothesis. This conclusion conflicts with that put forth by Devine (1968) after he reviewed a portion of this research. Devine rejected the transfer hypothesis based upon the work of R.F. Lewis (1963), Hollingsworth (1964), and Reeves (1965), all of whom failed to find evidence of transfer. However, in his review, Devine did not take into account the data reflecting the success of original auding training. As indicated in Table 6, the auding training provided by R.F. Lewis, Hollingsworth, and Reeves did not produce a significant improvement in the auding skills of their subjects. Therefore, the evidence cited by Devine as demonstrating the untenability of the transfer hypothesis provided, instead, examples of unsuccessful auding training programs. Given this failure of original training, transfer from auding to reading could not occur.

Chapter VI

SUMMARY AND IMPLICATIONS

REVIEW OF THE HYPOTHESES

In this chapter we will bring our discussion of the developmental model of reading to a close. It is not a finished effort—that would mean that we thoroughly understood all aspects of the problem and had a complete, articulated, validated model, which we do not have. At this point, however, we need to take stock of what has been accomplished, and point to directions for future efforts in developing, refining, and validating the model of reading development. Then, we need to draw implications for education and training to improve the acquisition of reading competency, and of the oracy and conceptualizing competencies that serve as foundations for reading, and for learning *by* language in general.

The major thesis of the developmental model of reading which we are constructing is that the person comes into the world with certain basic adaptive processes which he uses to build a cognitive content and to acquire language competency. The bulk of this competency is verbal language competency, acquired and expressed by auding and speaking, respectively. In learning to read, the child uses the same cognitive content and languaging competencies used earlier in auding, plus the additional competencies involved in decoding print-to-language.

Literature was reviewed bearing on four hypotheses which *must follow* if the foregoing is an accurate statement of interdependencies among auding and reading:

Hypothesis 1

Oracy reception (auding), vocabulary, and ability to comprehend language by auding ought to surpass reading vocabulary and ability to comprehend language by reading in the early years of schooling; this gap should close as the child acquires reading ability. Review of literature related to Hypothesis 1 indicated that, in the early years of schooling, languaging by auding was more effective than languaging by reading for receiving communication, whereas these processes became equally effective sometime around the seventh or eighth grades. Thus Hypothesis 1 was confirmed.

Hypothesis 2

Ability to comprehend language by auding should be predictive of ability to comprehend language by reading when that skill is developed beyond the decoding stage. Literature review indicated that the accuracy of predicting reading ability from auding ability increased from first grade to fourth grade, and was stable thereafter, with a correlation coefficient of approximately +.60—a coefficient which we estimate to be low due to differences in the task variables involved in the various studies relating auding to reading. Despite this, however, Hypothesis 2 was confirmed.

Hypothesis 3

Rate of languaging and conceptualizing should produce comparable optimal rates of auding and reading when the latter skill is developed beyond the learning-to-decode stage. Evidence reviewed favored Hypothesis 3 and suggested that maximal rate of silent reading with accurate retention corresponds closely to maximal rates of speaking and auding, with 250-300 words per minute representing a best rough estimate of the optimal rates for these processes.

Hypothesis 4

Training in comprehending by auding of a particular genre (e.g., "critical listening") should transfer to reading when that skill is developed beyond the learning-to-decode period. Review of literature disclosed that many studies bearing on this hypothesis were not adequately designed to unambiguously reveal transfer effects, if these were in fact obtained. Studies that were most adequately designed confirmed Hypothesis 4, and suggested that transfer was most likely to be evidenced when the skills and knowledges of the auding training and measurement tests more closely resembled the skills and knowledges of the tests used to measure reading ability. This is consistent with the assertion of the developmental model that auding and reading offer alternative in-roads into the same languaging and conceptual competencies; thus when new competency is added via auding, it becomes accessible via reading (the reverse should also be true, but no studies were found testing transfer from reading to auding).

The confirmation of each of the four hypotheses stated above provides evidence for the developmental model of reading. Reading is based upon, and utilizes the same conceptual base and languaging competencies used in auding, plus the additional competencies used in converting the visual display into an internal auditory display.

An implication of considerable impact from this conclusion is that, while skill in reading decoding is necessary for accuracy and efficiency in comprehension of what is read, it is not sufficient. Limitation in reading comprehension may reflect both decoding problems and restricted oral language and conceptualizing competencies. Thus, decoding may be excellent, but if vocabulary, knowledge, and thinking processes are limited, reading comprehension (and, hence, performance contingent on such comprehension) will suffer.

To some, the foregoing statements may appear true but trite. After all, haven't reading teachers and other educators always recognized the need to teach both reading decoding and comprehension skills? The answer is yes—except that, as we have seen, reading comprehension skills do not depend as much upon reading as they do upon language and conceptualizing competency developed largely by means of oracy skills. Thus much of what is referred to as a *reading* comprehension problem could, just as readily, be referred to as an *auding* comprehension problem. In turn, the latter process will be limited by the person's linguistic and semantic knowledge, and his ability to use that knowledge to get more knowledge from the spoken language display (i.e., to conceptualize).

The fact that the distinctions being drawn here between conceptual base, oral language competency, and reading have frequently been blurred is evidenced by the following practices which, when considered in light of the developmental model, are ill-advised.

(1) Trying to teach reading in adult basic education classes in "concentrated" programs of some 100 to 200 hours. Such attempts naively fail to distinguish between teaching some decoding skills, usually confounded with also teaching new vocabulary using printed words which are not in the oracy competency of the learner, and developing knowledge structures in the student's conceptual base to which new vocabulary may be related. Since knowledge structures are achieved only over long periods of time—four years of high school are used to present college entry foundations in most specialized areas such as social studies and biological sciences—it is naive to believe that Adult Basic Education (ABE) can take a person whose language and cognitive content is almost universally found to be very restricted, and in a few hours of phonics training with some "general" reading and "general education" produce a literate adult with the language and cognitive capabilities of the typical 8th-or 12th-grade student.

(2) Trying to assess the impact of pre-school training in oral language skills on learning to read in the first or second grades before the reading decoding skills are adequately developed. There is no reason to expect oracy training to affect learning the decoding skills of reading (see page 72). Rather, the impact of such training on comprehension should be sought after the bulk of the decoding skills have been acquired—in the third or fourth grades.

(3) Trying to produce speeds of "reading" well over 300 words per minute without recognizing that the speed of reading is limited by the speed of languaging and conceptualizing. The "fact" of high-speed reading is not only peddled by enterprising individuals and concerns, it is also frequently pointed to when distinctions between auding and reading are being drawn in scientific books concerned with the nature of reading (see p. 57; also Neisser, 1967; Mattingly, 1972). But the developmental model (Hypothesis 3 of Chapter V) makes clear that such "reading" cannot occur. It is more likely that speed readers utilize less and less reading (languaging via print) and more and more conceptualizing—creating a story out of fragments of text. Thus, although page after page of text may be scanned and flipped through, it is a gross error to report reading speed in terms of the words on the pages divided by the time needed to flip the pages. Such a process is not the reading process used by the national sample described in Chapter V, nor is it primarily reading at all. It is scanning and constructing a story. At any rate (no pun!) the burden of proof for speed "reading", and hence for the use of this concept as a factor distinguishing languaging by eye and by ear, rests on those making the assertions. We have found no evidence for speed "reading".

(4) Trying to produce tests of "listening" that produce scores not correlated with tests of reading, that is, trying to test a separate "listening" factor. Thus, concern has been expressed that "listening" ability tests and reading ability tests frequently correlate highly, and, therefore, the "listening" tests do not measure some independent "listening" ability and hence are not useful (*cf*., Russell, in Duker, 1968; Spearritt, 1961; Lundsteen, 1969; Brown, in Duker, 1968). Yet, following the developmental model of reading, we see that auding comprehension and reading comprehension tests should be highly correlated—as long as auding and reading factors, but not listening and looking or decoding factors, are primarily influencing test performance. In fact, however, most auding tests are called "listening" tests and fail to exclude undue reliance on short-term memory by permitting re-auding; they may include following a

sequence of sounds; sometimes they require the recognition of non-speech sounds and language in the same test battery (Witkin, 1971). In short, they may represent a variety of listening and conceptualizing tasks that may or may not involve language. The surprising factor is that "listening" and reading tests do so frequently correlate above .60. The developmental model suggests that we should strive to construct auding and reading test batteries that are even more highly correlated and that can, therefore, index the closing of the gap between auding and reading as languaging processes during the early period of acquisition of decoding skills, and the equivalency of the two processes for languaging after the decoding skills are acquired.

(5) Trying to test reading comprehension using knowledge derived from "typical" school curricula rather than the language and conceptual bases of the students at hand—to the disadvantage of those students who have not participated in the curricula from which test items are drawn. This problem has come to the foreground today, with the concern for accountability and the emergence of the concept of criterion-referenced tests that a local school district can use to test what is being learned of what is being taught. Careful attention to the interrelationships among conceptual base, language ability, and reading—as in the developmental model—points to the desirability of reading tests that do not rely upon specific content area knowledge for their performance, or that separate content knowledge from assessment of the ability to access language and conceptual bases via the graphic signaling system.

Admittedly this is a difficult thing to do; testing reading comprehension requires the use of some content. Yet many standardized tests contain "standardized curricula" content, and many students can score high on such tests without even reading the passages acccompanying the test items (Tuinman, 1972-73). This may penalize the student who lacks the content knowledge and must spend precious testing time trying to extract that knowledge. Perhaps one way to overcome the content problem is to devise procedures for teachers to obtain materials spoken by students which can be typed and presented as reading materials. This would at least ensure that the content of the reading materials is familiar to the student. Carver (1971b) has expressed similar concern about the need for tests that measure how well students can read, rather than what they know about some content area.

In addition, it seems to us that failure to consider factors articulated in the developmental model has focused an inordinate amount of research and development on the *decoding* phase of learning to read, at the expense of attention to the oracy, languaging, and conceptualizing (cognitive) competencies required for comprehending language by reading. We will comment further on this problem in the next section. For the present, we conclude that, for the above reasons, the prolonged analysis of the "common sense" notion that children first are endowed with basic adaptive processes, then they acquire oracy competency in language, and then reading is added to this hierarchy, performs a useful service in showing how many common practices do not reflect "common sense". Why this is so is due, we believe, to the lack of attention to the implications of the very general developmental sequence described in this report. We will discuss more general and specific implications for research and development later in this chapter.

SOME ACCOMPLISHMENTS AND LIMITATIONS OF THE MODELING EFFORT

In this work we are attempting to develop a model of the development of reading ability which serves at least some of the purposes Gephart (p.16 of this report) says a model should serve:

(1) A model should explain what a complex phenomenon consists of. In the present case we have argued that reading consists of conceptual and language content and processes, as well as certain decoding-to-speech processes in the learning-to-read stage, and information-processing skills involved in looking, such as the parallel processing of information from the focus and margin of visual attention. The major significance of this analysis is that the process called *reading* is seen to represent simply an alternative method of processing information from a language display, and that the major factors which may limit an individual level of achievement in comprehending graphic language are to be found in limitations in languaging and conceptualizing. Thus, for instance, we may expect that major problems experienced by high school graduates who are reading at the sixth-grade level or so are more likely to be due to limitations in language and conceptual competencies, rather than to reading decoding skills, although the latter may also be less than optimally developed.

Obviously our description of reading as a languaging process is a very molar level of description. We have not presented a detailed account of the "reading process"—what the stages of information-processing are when the eye falls upon the printed page. Nor have we detailed what language consists of as a foundation for reading. Explicit formulations of the conceptual base and the processes involved in conceptualizing and languaging have been ignored. Thus the model is limited to the "surface" level of description of a developmental sequence.

(2) A model should describe how such a phenomenon works. The phenomenon we have been concerned with is a developmental sequence. To adequately describe how it works, one would have to state the necessary and sufficient conditions by which BAP and environmental factors interact to produce language, and how oral language competency becomes written language competency. While we have not attempted this complete description of how the phenomenon works, we have tried to indicate how various information-processing activities—conceptualizing, languaging, looking, and listening—act to provide the basis for the acquisition of reading. Furthermore, we expressed our belief (and supported this belief with literature review regarding four hypotheses) that reading "works" by utilizing the same languaging and conceptualizing processes involved in auding, plus the processes involved in decoding print-to-speech and in accurately guiding the eye from one point of fixation to the next. Thus our explanation of how the developmental model "works" to produce reading has been in terms of the emerging interrelations among a variety of general information-processing activities.

(3) A model should provide the basis for predictions about changes which will occur in one element of the phenomenon when changes are made in another element. In the present case, we have emphasized relationships among language and auding and reading, and have indicated how changes in reading comprehension should change when language competency is changed via auding training (Hypothesis 4, Chapter V). We have also indicated that such training should not be expected to improve the acquisition of

reading decoding skills, and hence the effectiveness of oral language training in pre-school and primary grades should not be assessed in terms of proficiency in learning to read (decode).

On the negative side, we have not dealt with the problem of individual differences in transfer of language competency acquired via oracy training to reading comprehension. It is not known to what extent such transfer does not occur automatically, nor to what extent such training may facilitate the learning of the language or comprehension skill by reading; if it does not transfer automatically. Conditions for facilitating transfer are not dealt with, nor have we considered what types of oracy training might be most appropriate for transfer to reading when that skill is acquired. We have likewise found little to say about the effects of training in listening or looking on auding and reading. Nor have we dealt with the cognitive processes which underlie looking and listening, such as the person's implicit (or explicit) plans for pursuing a given looking or listening task—plans for scanning and remembering information, plans for problem solving, and so forth.[1]

In summary then, we see that the model satisfies each of Gephart's requirements to at least a limited degree. It does appear to present a valid description of the major process variables involved in the development of reading competency. By emphasizing the commonality of languaging and conceptualizing processes underlying oracy and literacy skills, we have hoped to place the latter in a better perspective.

It is typical nowadays to ascribe numerous education problems to literacy, and more specifically reading problems. What we have tried to do is show that reading is the tip of the iceberg. Underlying this tip is the vast expanse of language and cognition. It seems to us that while many people in the United States today acquire the reading decoding skills, and hence the tip of the iceberg, the icebergs themselves may be fairly small. Hopefully, they might be enlarged through training in languaging and conceptualizing via oracy skills, and hence provide a more substantive base for the capstone literacy skills of reading and writing.

IMPLICATIONS

(1) This review has indicated that reading ability is built upon a foundation of language abilities developed and expressed largely by means of the oracy skills of auding and speaking. For this reason, a much greater emphasis than has been shown in the past should be given to the development of:

(a) Methods for characterizing and assessing oral language as a developing ability and in relation to reading skills development. For instance, as mentioned earlier (pp. 61-62) an *auding-reading test battery* which could index the discrepancies between these skills would be useful in revealing the extent to which reading problems reflect difficulties in handling language in printed form or low levels of language in general. Only a very few of these instruments exist today (for children, not adults), and they do not reflect careful analysis of auding and reading processes. Nor do they take account of new technologies for presenting audio displays (e.g., inexpensive playback magnetic tape machines; time compression/expansion equipment for accelerating or decelerating speech rate; methods of indexing audio tapes) to permit students to preview, review, and control the rate of presentation of the audio message. Such techniques tend to equate the spoken and printed displays in terms of their *referability* (how easy it is to refer to, jump ahead, look backward, etc.) and may permit the development of improved auding-reading test batteries.

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[1] These types of cognitive plans are discussed by Farnham-Diggory, 1972.

(b) Methods for improving oral language skills as foundation skills for reading. In this regard, it would seem that, at least with beginning or unskilled readers, a sequence of instruction in which vocabulary and concepts are first introduced and learned via oracy skills would reduce the learning burden by not requiring the learning of both vocabulary and decoding skills at the same time. It is difficult to see how a person can learn to recognize printed words by "sounding them out" through some decoding scheme if, in fact, the words are not in the oral language of the learner. Thus, an *oracy-to-literacy* sequence of training would seem desirable in teaching new vocabulary and concepts to unskilled readers.

(2) As presented in the present model, both the oracy and the literacy language skills function to transmit and comprehend conceptualizations formed from knowledge stored in memory. It is necessary therefore that an auder or reader have an adequate, relevant knowledge base if comprehension of the spoken or printed message is to occur. This suggests that:

(a) There is a need for research to determine how "old" knowledge is used to acquire "new" knowledge by oracy and literacy skills. In order to learn new knowledge, an auder or reader must utilize some strategy for relating what he already knows to what is to be learned. Verbal learning studies have found, for instance, that subjects learning S-R lists of words make up mnemonic organizers, such as making a sentence of the S-R word pairs, to recall the lists. In other words they incorporate the new information (S—R pairs) into old information (a syntactical pattern). We need research to develop methods by which a person can take stock of what he already knows and manipulate this knowledge to 1) create new knowledge or 2) learn a new body of knowledge. Such research should also deal with methods for representing knowledge, and for assessing a person's knowledge vis-a-vis a to-be-learned body of knowledge.

(b) There is a need for research and development to ensure that students acquire the requisite knowledge base needed to perform significant adult literacy tasks. The concepts of general literacy and general educational development have long predominated in the educational institution. However, study of the K-12 curriculum, and especially the 9-12 curriculum indicates that, rather than developing general literacy skills, what are actually being developed are school-related literacy skills. Thus, the traditional "college-prep" program provides a body of knowledge relevant to the literacy and oracy tasks that will be encountered in college. The high school English program stresses the literary arts, poetry, interpretive writing, and so forth. It is possible, however, that such "general education" or "general literacy" training may not be too general. Many high school graduates of average intelligence find themselves unprepared for work—unprepared for performing many life management tasks requiring oracy and literacy skills. Thus, as far as *knowledge* is concerned, literacy may indeed be quite specific. To be able to read and follow complex directions for assembling/disassembling equipment, training in interpreting Milton may not suffice.

We need, then, to consider what is general in "general literacy" (perhaps the decoding skills in reading) and what *specific* knowledges are required for various literacy tasks. This may be even more important in the case of adult basic education where training programs may be limited in duration, and immediate "payoff" for learning to read is expected (e.g., job entry or promotion). In these cases it seems unlikely that general educational development (GED) involving reading in such subjects as social studies, history, life sciences, or English literature will offer much transfer to non-academic literacy tasks. We need to ensure that the relevant knowledge bases for accomplishing such tasks are identified and developed by students.

(3) Because high skill levels in reading presuppose high skill levels in decoding, in oral language, and in a broadly developed conceptual base, government agencies sponsoring remedial literacy programs ought to be prepared to offer support for programs of longer duration than they do currently. It must be realized that the development of *automaticity* in decoding, say in adult literacy training, requires considerable drill and practice—and this requires time. Much more importantly, however, it must be realized that the development of oral language skills and broad bases of knowledge require considerable practice, drill, study, and time for assimilation and accommodation processes to build cognitive structures (*cf.*, p. 27). Hence long-term commitments in adult basic education are needed, if such efforts are to truly develop accomplished students.

(4) Implications for Air Force literacy training. Because the Air Force is concerned with literacy training which will improve a person's capacity to accomplish his job and advance in his career, *job-related literacy training* should be emphasized in the remedial literacy program. This will build the most immediately relevant knowledge base. However, because learning the meanings of job-related terminology and concepts and developing automaticity in decoding job printed materials will require considerable time, the Air Force should consider a program of literacy training of sufficient duration, and with suitable job-related content, to promote fully developed job literacy skills. Such a program might operate concurrently with job training (following some pre-job-training literacy training for personnel whose oracy/literacy skills are so low that they cannot qualify for technical training), and be available to personnel on the job to prepare them for career advancement.

This type of program might be implemented with various self-study, audio-visual materials. *Computer-assisted instruction* would seem to lend itself to this type of job-related training because:

(a) The need to keep job-reading materials up-dated suggests the use of computer editing and revision of text capabilities to maintain currency of materials.

(b) The need to carefully assess students' knowledge in relation to the to-be-learned knowledge suggests the use of adaptive testing programs, and assessment procedures whereby a student may "dump" his knowledge about some concept according to some structured interview-type format, which the computer might then use to generate *personalized* materials to facilitate transfer of old knowledge to the learning of new knowledge.

(c) The need for drill and practice suggests the use of computers (which do not get bored by this type of activity) with programs for using *accuracy and response latency* data to determine when sufficient skill has developed.

While there is much need for basic research to pursue many of the above implications, technology exists to immediately implement the development of prototypical language-testing procedures and literacy training programs geared to job-specific knowledges and reading skills. What is needed now is commitment of resources to literacy training for Air Force career development.

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reading decoding skills, and hence the effectiveness of oral language training in pre-school and primary grades should not be assessed in terms of proficiency in learning to read (decode).

On the negative side, we have not dealt with the problem of individual differences in transfer of language competency acquired via oracy training to reading comprehension. It is not known to what extent such transfer does not occur automatically, nor to what extent such training may facilitate the learning of the language or comprehension skill by reading; if it does not transfer automatically. Conditions for facilitating transfer are not dealt with, nor have we considered what types of oracy training might be most appropriate for transfer to reading when that skill is acquired. We have likewise found little to say about the effects of training in listening or looking on auding and reading. Nor have we dealt with the cognitive processes which underlie looking and listening, such as the person's implicit (or explicit) plans for pursuing a given looking or listening task—plans for scanning and remembering information, plans for problem solving, and so forth.[1]

In summary then, we see that the model satisfies each of Gephart's requirements to at least a limited degree. It does appear to present a valid description of the major process variables involved in the development of reading competency. By emphasizing the commonality of languaging and conceptualizing processes underlying oracy and literacy skills, we have hoped to place the latter in a better perspective.

It is typical nowadays to ascribe numerous education problems to literacy, and more specifically reading problems. What we have tried to do is show that reading is the tip of the iceberg. Underlying this tip is the vast expanse of language and cognition. It seems to us that while many people in the United States today acquire the reading decoding skills, and hence the tip of the iceberg, the icebergs themselves may be fairly small. Hopefully, they might be enlarged through training in languaging and conceptualizing via oracy skills, and hence provide a more substantive base for the capstone literacy skills of reading and writing.

IMPLICATIONS

(1) This review has indicated that reading ability is built upon a foundation of language abilities developed and expressed largely by means of the oracy skills of auding and speaking. For this reason, a much greater emphasis than has been shown in the past should be given to the development of:

(a) Methods for characterizing and assessing oral language as a developing ability and in relation to reading skills development. For instance, as mentioned earlier (pp. 61-62) an *auding-reading test battery* which could index the discrepancies between these skills would be useful in revealing the extent to which reading problems reflect difficulties in handling language in printed form or low levels of language in general. Only a very few of these instruments exist today (for children, not adults), and they do not reflect careful analysis of auding and reading processes. Nor do they take account of new technologies for presenting audio displays (e.g., inexpensive playback magnetic tape machines; time compression/expansion equipment for accelerating or decelerating speech rate; methods of indexing audio tapes) to permit students to preview, review, and control the rate of presentation of the audio message. Such techniques tend to equate the spoken

[1] These types of cognitive plans are discussed by Farnham-Diggory, 1972.

and printed displays in terms of their *referability* (how easy it is to refer to, jump ahead, look backward, etc.) and may permit the development of improved auding-reading test batteries.

(b) Methods for improving oral language skills as foundation skills for reading. In this regard, it would seem that, at least with beginning or unskilled readers, a sequence of instruction in which vocabulary and concepts are first introduced and learned via oracy skills would reduce the learning burden by not requiring the learning of both vocabulary and decoding skills at the same time. It is difficult to see how a person can learn to recognize printed words by "sounding them out" through some decoding scheme if, in fact, the words are not in the oral language of the learner. Thus, an *oracy-to-literacy* sequence of training would seem desirable in teaching new vocabulary and concepts to unskilled readers.

(2) As presented in the present model, both the oracy and the literacy language skills function to transmit and comprehend conceptualizations formed from knowledge stored in memory. It is necessary therefore that an auder or reader have an adequate, relevant knowledge base if comprehension of the spoken or printed message is to occur. This suggests that:

(a) There is a need for research to determine how "old" knowledge is used to acquire "new" knowledge by oracy and literacy skills. In order to learn new knowledge, an auder or reader must utilize some strategy for relating what he already knows to what is to be learned. Verbal learning studies have found, for instance, that subjects learning S-R lists of words make up mnemonic organizers, such as making a sentence of the S-R word pairs, to recall the lists. In other words they incorporate the new information (S—R pairs) into old information (a syntactical pattern). We need research to develop methods by which a person can take stock of what he already knows and manipulate this knowledge to 1) create new knowledge or 2) learn a new body of knowledge. Such research should also deal with methods for representing knowledge, and for assessing a person's knowledge vis-a-vis a to-be-learned body of knowledge.

(b) There is a need for research and development to ensure that students acquire the requisite knowledge base needed to perform significant adult literacy tasks. The concepts of general literacy and general educational development have long predominated in the educational institution. However, study of the K-12 curriculum, and especially the 9-12 curriculum indicates that, rather than developing general literacy skills, what are actually being developed are school-related literacy skills. Thus, the traditional "college-prep" program provides a body of knowledge relevant to the literacy and oracy tasks that will be encountered in college. The high school English program stresses the literary arts, poetry, interpretive writing, and so forth. It is possible, however, that such "general education" or "general literacy" training may not be too general. Many high school graduates of average intelligence find themselves unprepared for work—unprepared for performing many life management tasks requiring oracy and literacy skills. Thus, as far as *knowledge* is concerned, literacy may indeed be quite specific. To be able to read and follow complex directions for assembling/disassembling equipment, training in interpreting Milton may not suffice.

We need, then, to consider what is general in "general literacy" (perhaps the decoding skills in reading) and what *specific* knowledges are required for various literacy tasks. This may be even more important in the case of adult basic education where training programs may be limited in duration, and immediate "payoff" for learning to read is expected (e.g., job entry or promotion). In these cases it seems unlikely that general educational development (GED) involving reading in such subjects as social studies, history, life sciences, or English literature will offer much transfer to non-academic literacy tasks. We need to ensure that the relevant knowledge bases for accomplishing such tasks are identified and developed by students.

(3) Because high skill levels in reading presuppose high skill levels in decoding, in oral language, and in a broadly developed conceptual base, government agencies sponsoring remedial literacy programs ought to be prepared to offer support for programs of longer duration than they do currently. It must be realized that the development of *automaticity* in decoding, say in adult literacy training, requires considerable drill and practice—and this requires time. Much more importantly, however, it must be realized that the development of oral language skills and broad bases of knowledge require considerable practice, drill, study, and time for assimilation and accommodation processes to build cognitive structures (*cf.*, p. 27). Hence long-term commitments in adult basic education are needed, if such efforts are to truly develop accomplished students.

(4) Implications for Air Force literacy training. Because the Air Force is concerned with literacy training which will improve a person's capacity to accomplish his job and advance in his career, *job-related literacy training* should be emphasized in the remedial literacy program. This will build the most immediately relevant knowledge base. However, because learning the meanings of job-related terminology and concepts and developing automaticity in decoding job printed materials will require considerable time, the Air Force should consider a program of literacy training of sufficient duration, and with suitable job-related content, to promote fully developed job literacy skills. Such a program might operate concurrently with job training (following some pre-job-training literacy training for personnel whose oracy/literacy skills are so low that they cannot qualify for technical training), and be available to personnel on the job to prepare them for career advancement.

This type of program might be implemented with various self-study, audio-visual materials. *Computer-assisted instruction* would seem to lend itself to this type of job-related training because:

(a) The need to keep job-reading materials up-dated suggests the use of computer editing and revision of text capabilities to maintain currency of materials.

(b) The need to carefully assess students' knowledge in relation to the to-be-learned knowledge suggests the use of adaptive testing programs, and assessment procedures whereby a student may "dump" his knowledge about some concept according to some structured interview-type format, which the computer might then use to generate *personalized* materials to facilitate transfer of old knowledge to the learning of new knowledge.

(c) The need for drill and practice suggests the use of computers (which do not get bored by this type of activity) with programs for using *accuracy and response latency* data to determine when sufficient skill has developed.

While there is much need for basic research to pursue many of the above implications, technology exists to immediately implement the development of prototypical language-testing procedures and literacy training programs geared to job-specific knowledges and reading skills. What is needed now is commitment of resources to literacy training for Air Force career development.

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